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DEPARTMENT OF THE ARMY TECHNICAL MANUAL TM 11-5820-334-35

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER TO 31R1-2URR-422

FIELD AND DEPOT MAINTENANCE MANUAL

RADIO RECEIVER R-392/URR

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

21 AUGUST 1961

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DEPARTMENTS OF THE ARMY
AND THE AIR FORCE

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RADIO RECEIVER R-392/URR

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*This manual, together with TM 11-5820-334-10, 7 November 1960 and TM 11-5820-334-20, 27 December 1960, supersedes TM 11-858, 27 April 1954 including C1, 30 December 1955; C2, 26 July 1956; C3 7 December 1956; C4, 7 February 1957; C5, 6 June 1960.

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CHAPTER 1
THEORY

Section I. BLOCK DIAGRAM

1. Scope

a. This manual covers field and depot maintenance for Radio Receiver R-392/URR. It includes instructions appropriate to third, fourth, and fifth echelons for troubleshooting, testing, aligning, and repairing specified maintenance parts. It also lists tools, materials, and test equipment required for maintenance. Detailed functions of the equipment are covered in this chapter.

b. The complete technical manual for this equipment includes the following other publications: TM 11-5820-334-10, TM 11-5820-334-20, TM 11-5820-334-20P, and TM 11-5820-334-35P.

c. Forward comments concerning this manual to the Commanding Officer, U. S. Army Signal Materiel Support Agency, ATTN: SIGMS-PA2d, Fort Monmouth, N.J.

Note. For applicable forms and records, see paragraph 2, TM 11–5820–334–10.

2. Block Diagram Discussion (fig. 1)

Radio Receiver R-392/URR is a vehicular receiver that provides reception of voice (amplitude-modulated (am.)), tone-modulated radiotelegraph (modulated continuous wave (mcw)), unmodulated radiotelegraph (continuous-wave (cw)), and frequency-shift, single-channel radioteletype signals within a frequency range of 0.5 to 32 megacycles (mc). The frequency range is covered in 32 bands of 1-mc width each with the exception of the first band (0.5 to 1 mc), which covers 500 kilocycles (kc). An internal calibration oscillator permits accurate calibration of the countertype frequency indicator at 100-kc points throughout the entire frequency range of the receiver. Two receiver outputs are available at the front panel: a 200-milliwatt (ms) audio signal for use with a 600-ohm impedance headset or loudspeaker and a 455-kc intermediate-frequency (if.) signal for use with a 50-ohm impedance frequency-shift, single-channel radioteletype converter. The block diagram shows the signal path from the antenna through the various stages to the output. A schematic diagram (fig. 81) shows details of the circuits in the same order. Radio Receiver R-392/URR obtains both filament and plate circuit voltages directly from a vehicular electrical system or similar electrical supply.

a. Antenna Circuits. Radiofrequency (rf) signals are applied to the receiver from the antenna input. Antenna relay K101 grounds the antenna input during transmission (break-in operation) when the receiver is used with an associated transmitter. This relay is also activated in the receiver standby and calibration functions. The rf signals pass to first rf amplifier V201 through one of several antenna tuning networks, as determined by the operating frequency of the receiver.

b. Calibration Oscillator. The calibration oscillator provides a calibration signal every 100 kc within the frequency range of the receiver when the AGC switch is set to CAL. The 200-kc oscillator (V702) supplies a signal for synchronizing multivibrator V701 at 100 kc. Harmonic amplifier V703A amplifies the harmonics of the multivibrator output to provide a strong calibration signal at the 100-kc points. Distorter V703B further increases the harmonic content of the output of the harmonic amplifier and produces a signal which is applied to the input of first rf amplifier V201.

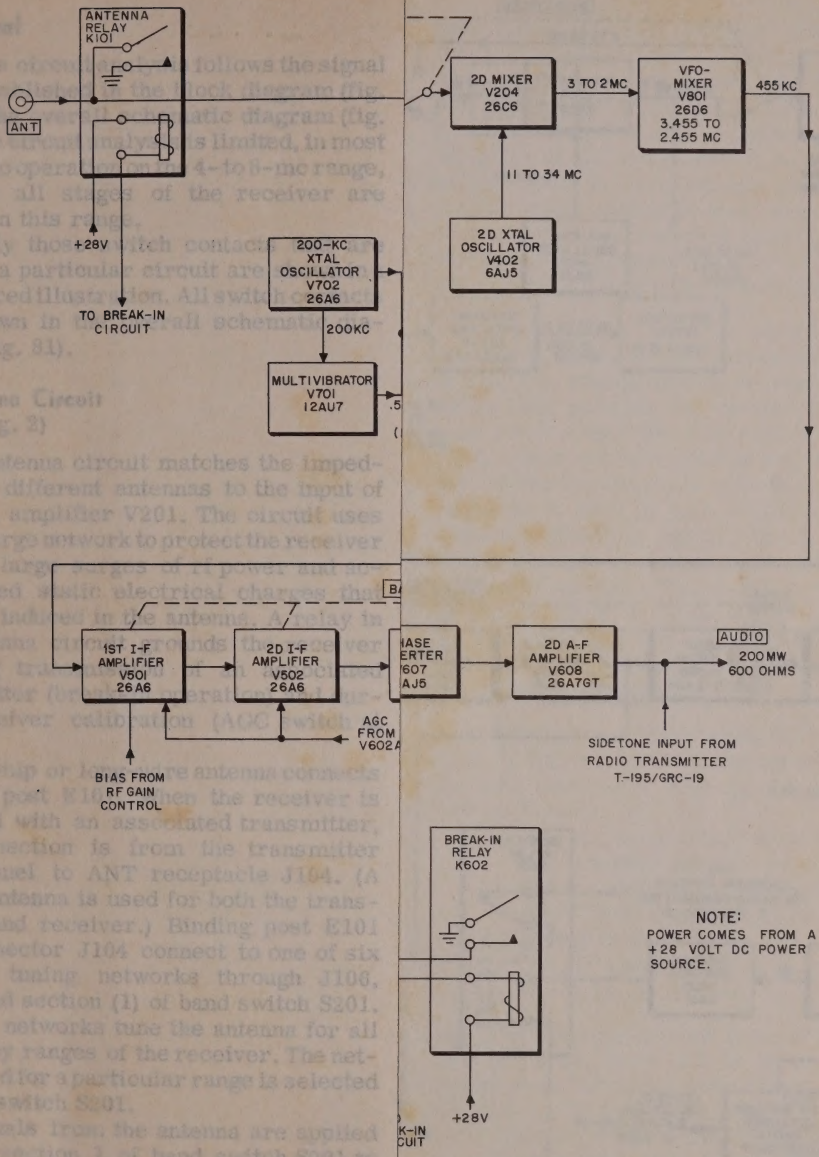
c. Rf Amplifiers and Mixers. The output of first rf amplifier V201 is coupled to second rf amplifier V202. The gain of the first and second rf amplifiers is controlled manually by the RF GAIN SQUELCH

THRESH control and automatically by two separate automatic gain control (agc) circuits. The output of second rf amplifier V202 is applied to either the first or the second mixer, depending on the setting of the MEGACYCLES control. For settings from 0.5 to 8 mc, the rf signal is mixed-with from 0.5 to 8 mc, the rf signal is mixed with the output of first crystal oscillator V401 in first mixer V203 to produce an if. signal from 9 to 18 mc. For settings from 8 to 32 mc, the rf signal is applied directly from the output of second rf amplifier V202 to second mixer V204. The heterodyning signal for V204 is supplied by second crystal oscillator V402. The if. range of the second mixer output signal is 3 to 2 mc except for the 0.5 to 1-mc band, where it has a range of 2.5 to 2 mc. This variable if. signal is heterodyned with the 3,455- to 2,445-kc output of the oscillator portion of variable frequency oscillator-mixer (vfo-mixer) V801 to produce a fixed 455-kc if.

d. If. Amplifiers, Bfo, Detector, and Noise Limiter. The 455-kc output signal of vfo-mixer V801 is applied to first if. amplifier V501. The if. subchassis consists of six amplifiers, V501 through V506. Three degrees of bandwidth are selected by the BAND WIDTH switch. The output of fifth if. amplifier V505 is applied to sixth if. amplifier V506 and agc if. amplifier V609. The output signal from V506 is demodulated in detector V603A. With the function switch set to LIMITER, noise limiter V603B clips the noise peaks from the detector output signal and applies it to first audiofrequency (af) amplifier V606. No clipping takes place in other function switch positions. Beat-frequency oscillator (bfo) V604 furnishes a signal within a range from 451 to 459 kc for receiving cw signals and calibrating the receiver. The bfo output is heterodyned with the 455-kc if. signal from sixth if. amplifier V506 to produce an audiofrequency beat note in the detector output.

e. Audio Amplifiers. Audio signals from the detector are fed through noise limiter V603B to first af amplifier V606. The output of V606 is applied to phase inverter V607, which provides two equal output voltages 180° out of phase. These two voltages are applied to second af amplifier V608. The output of V608 is to the AUDIO receptacles on the front panel. A sidetone signal is furnished by the transmitter to the headset or speaker for monitoring the transmitter when the receiver is used as part of Radio Set AN/GRC-19.

f. Agc and If. Cathode Follower. Agc if. amplifier V609 is a buffer between fifth if. amplifier V505 and the agc rectifiers and the squelch rectifier and IF OUT connector. The isolation provided by V609 permits reception of radioteletype signals with the BFO switch set to ON. The signal from V609 is rectified in first rf agc rectifier V601B (AGC switch at ON or CAL) and applied as bias to first rf amplifier V201 to automatically control the gain of that stage. Rf and if. agc rectifier V602A provides agc bias for the second rf amplifier and the first and second if. amplifiers. A separate agc system is used for the first rf amplifier to prevent receiver blocking by nearby transmitter signals. This circuit arrangement prevents strong off-tune rf signals in the first rf amplifier from biasing succeeding rf and if. amplifiers through a common agc circuit. If. cathode follower V601A provides a low-impedance output connection (50 ohms) at the IF OUT connector for received frequency-shift radioteletype signals.



NOTE:
POWER COMES FROM A +28 VOLT DC POWER SOURCE.

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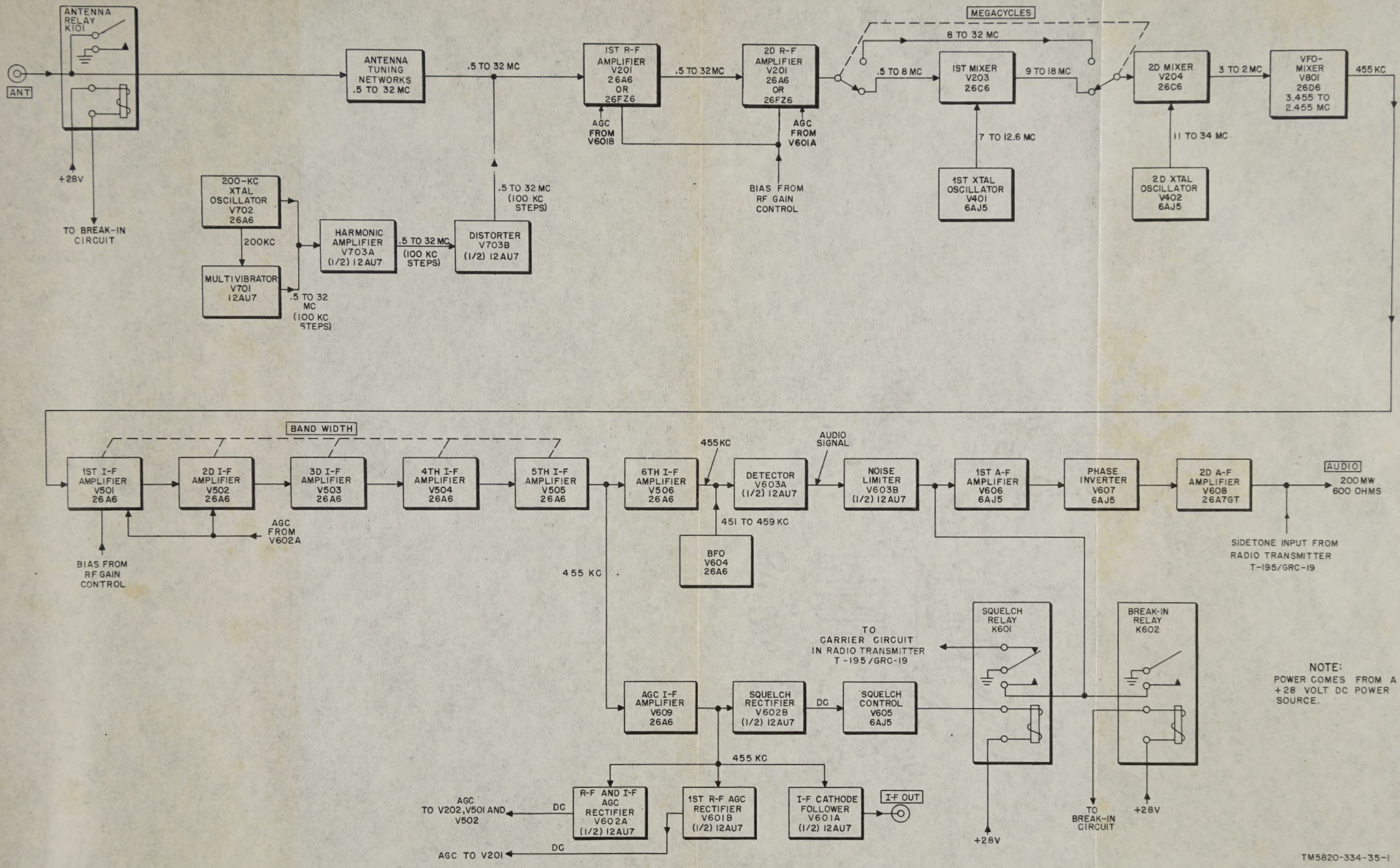
ANTENNA RELAY K101
ANT
+28V
TO BREAK-IN CIRCUIT
ANTENNA TUNING NETWORKS .5 TO 32 MC
.5 TO 32 MC
1ST R-F AMPLIFIER V201 26A6 OR 26FZ6
.5 TO 32 MC
2D R-F AMPLIFIER V201 26A6 OR 26FZ6
AGC FROM V601B
AGC FROM V601A
BIAS FROM RF GAIN CONTROL
MEGACYCLES
8 TO 32 MC
.5 TO 8 MC
1ST MIXER V203 26C6
9 TO 18 MC
7 TO 12.6 MC
1ST XTAL OSCILLATOR V401 6AJ5
2D MIXER V204 26C6
3 TO 2 MC
11 TO 34 MC
2D XTAL OSCILLATOR V402 6AJ5
VFO-MIXER V801 26D6 3,455 TO 2,455 MC
455 KC
200-KC XTAL OSCILLATOR V702 26A6
200KC
MULTIVIBRATOR V701 12AU7
.5 TO 32 MC (100 KC STEPS)
HARMONIC AMPLIFIER V703A (1/2) 12AU7
.5 TO 32 MC (100 KC STEPS)
DISTORTER V703B (1/2) 12AU7
.5 TO 32 MC (100 KC STEPS)
BAND WIDTH
1ST I-F AMPLIFIER V501 26A6
2D I-F AMPLIFIER V502 26A6
3D I-F AMPLIFIER V503 26A6
4TH I-F AMPLIFIER V504 26A6
5TH I-F AMPLIFIER V505 26A6
6TH I-F AMPLIFIER V506 26A6
455KC
DETECTOR V603A (1/2) 12AU7
AUDIO SIGNAL
NOISE LIMITER V603B (1/2) 12AU7
1ST A-F AMPLIFIER V606 6AJ5
PHASE INVERTER V607 6AJ5
2D A-F AMPLIFIER V608 26A7GT
AUDIO
200 MW 600 OHMS
AGC FROM V602A
BIAS FROM RF GAIN CONTROL
451 TO 459 KC
BFO V604 26A6
455 KC
SIDETONE INPUT FROM RADIO TRANSMITTER T-195/GRC-19
SQUELCH RELAY K601
BREAK-IN RELAY K602
TO CARRIER CIRCUIT IN RADIO TRANSMITTER T-195/GRC-19
AGC I-F AMPLIFIER V609 26A6
SQUELCH RECTIFIER V602B (1/2) 12AU7
DC
SQUELCH CONTROL V605 6AJ5
455 KC
AGC TO V202, V501 AND V502
DC
R-F AND I-F AGC RECTIFIER V602A (1/2) 12AU7
1ST R-F AGC RECTIFIER V601B (1/2) 12AU7
I-F CATHODE FOLLOWER V601A (1/2) 12AU7
I-F OUT
DC
AGC TO V201
+28V
TO BREAK-IN CIRCUIT
+28V
NOTE:
POWER COMES FROM A +28 VOLT DC POWER SOURCE.
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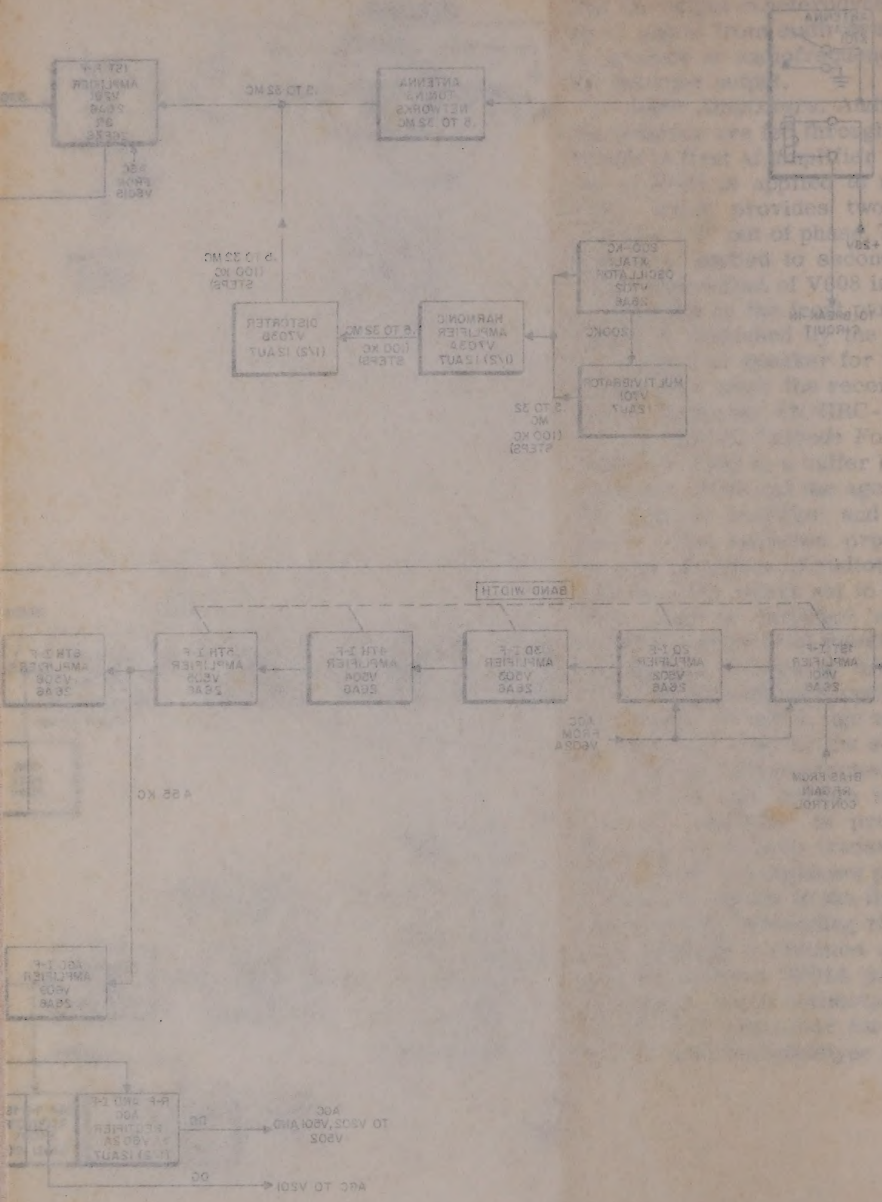
Figure 1. Radio Receiver R-392/URR, block diagram.


BAND WIDTH
AGC TO V502, V801 AND V802
AGC TO V801

Section II. CIRCUIT ANALYSIS

3. General

a. The circuit analysis follows the signal path established in the block diagram (fig. 1) and the overall schematic diagram (fig. 81). The circuit analysis is limited, in most cases, to operation on the 4- to 8-mc range, because all stages of the receiver are active on this range.

b. Only those switch contacts that are used in a particular circuit are shown in a referenced illustration. All switch contacts are shown in the overall schematic diagram (fig. 81).

4. Antenna Circuit (fig. 2)

The antenna circuit matches the impedance of different antennas to the input of first if. amplifier V201. The circuit uses a discharge network to protect the receiver against large surges of rf power and accumulated static electrical charges that may be induced in the antenna. A relay in the antenna circuit grounds the receiver during transmission of an associated transmitter (break-in operation) and during receiver calibration (AGC switch at CAL).

a. A whip or long-wire antenna connects to ANT post E101. When the receiver is operated with an associated transmitter, the connection is from the transmitter front panel to ANT receptacle J104. (A single antenna is used for both the transmitter and receiver.) Binding post E101 and connector J104 connect to one of six antenna tuning networks through J106, P206, and section (1) of band switch S201. The six networks tune the antenna for all frequency ranges of the receiver. The network used for a particular range is selected by band switch S201.

b. Signals from the antenna are applied through section 1 of band switch S201 to 4- to 8-mc antenna-tuning network Z204A. ANT TRIM capacitor C202A is used for the 4- to 8-mc range. The primary and secondary of the transformer in Z204A are tuned by variable powdered-iron cores, which are positioned by the MEGACYCLES and KILOCYCLES controls. Capacitors C310 and C314 provide capacity for resonant circuits. Capacitors C311 and C313 are alignment trimmers, and C312 improves the frequency response characteristics of the transformer. In frequency ranges from 0.5 to 2 mc and 16 to 32 mc, single-tuned networks are used. The rf voltage developed across L238 is applied through switch S201, section 2 (rear) to the control grid of first rf amplifier V201.

c. Section 2 of S201 short-circuits Z203A, to prevent reactive effects between it and the tuning circuit in use. Antenna relay K101 grounds the antenna input circuit when either the AGC switch is set to CAL, the function switch is set to STAND BY, or during break-in operation when the receiver is used as part of Radio Set AN/GRC-19. Resistor R102 bleeds off any static electrical charge on the antenna. If unusually strong rf currents are induced in the antenna, such as might be caused by transmission from an adjacent transmitter, glowlamp I101 conducts and passes the current to ground.

d. Six-position band switch S201 is operated by the MEGACYCLES control. When the band switch is rotated, the following actions occur:

(1) One of six antenna-tuning networks is connected into the input circuit.
(2) One or both of the two sections of ANT TRIM capacitor C202 are connected in the antenna circuit.
(3) One of the unused antenna-tuning networks is shorted.

e. The antenna circuit covers the frequency range from 0.5 to 32 mc in six ranges with six tuning networks as follows: 0.5 to 1 mc (Z201), 1 to 2 mc (Z202), 2 to 4 mc (Z203A), 4 to 8 mc (Z204A), 8 to 16 mc (Z205A), and 16 to 32 mc (Z206). The core within the inductor of each tuning network is movable and is controlled by the MEGACYCLES and KILOCYCLES controls, except for the 0.5- to 1-mc and 1- to 2-mc bands, which are controlled by the KILOCYCLES control only.

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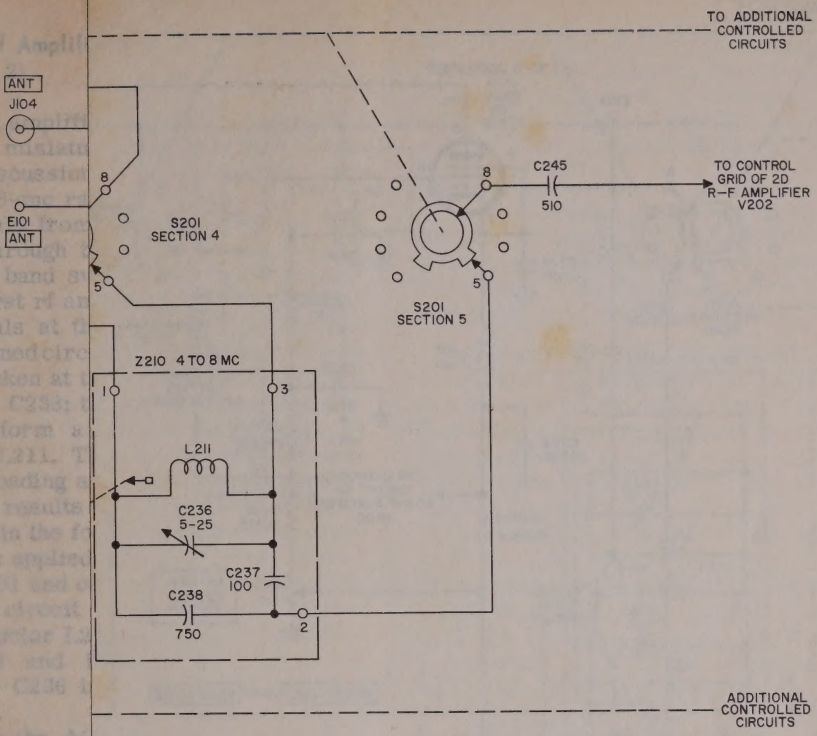

ES:
WISE SHOWN,
E IN UUF.
E IN OHMS.
IONS ARE SHOWN
IN THE 4 TO 8 MC RANGE.
OF SWITCHES USED IN
E SHOWN,
ARE VIEWED FROM THE
THE KNOB.

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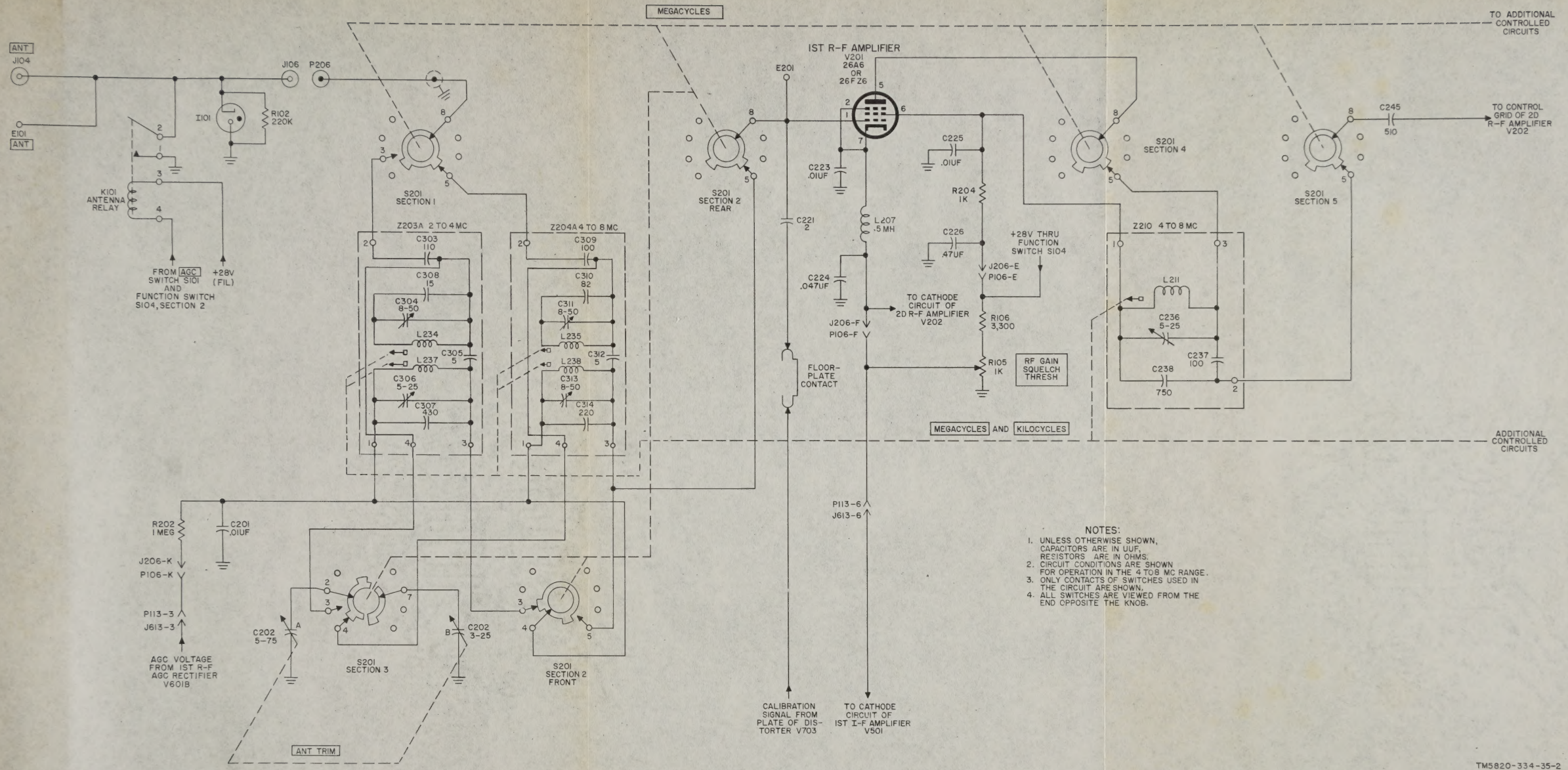
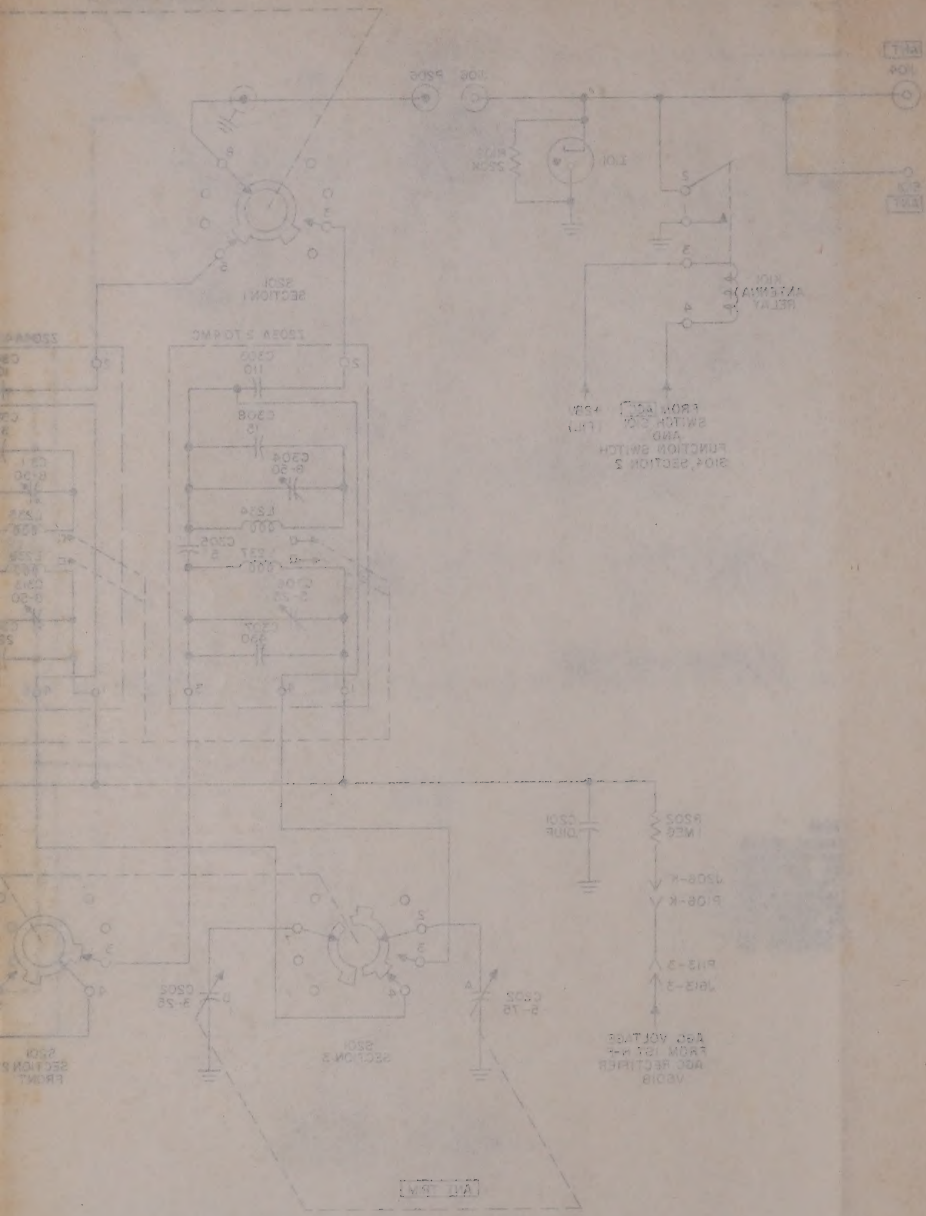


Figure 2. Antenna circuit and first rf amplifier, schematic diagram.



5. First Rf Amplifier V201
(fig. 2)

First rf amplifier V201 uses a type 26A6 or 26FZ6 miniature pentode tube. The following discussion is concerned only with the 4- to 8-mc range.

a. Signals from the antenna circuit are applied through the contacts of section 2 (rear) of band switch S201 to the control grid of first rf amplifier V201. The amplified signals at the plate of V201 are applied to tuned circuit Z210. The output from V201 is taken at the junction of capacitors C237 and C238; the series-connected capacitors form a voltage divider across inductor L211. This circuit arrangement reduces loading and minimizes any detuning that results from tube-capacitance variation in the following stage. The output of V201 is applied through section 5 of band switch S201 and coupling capacitor C245 to the grid circuit of second rf amplifier V202. Inductor L211 is tuned by the MEGACYCLES and KILOCYCLES controls. Capacitor C236 is an alignment trimmer capacitor.

b. When the AGC switch is set to ON, bias for first rf amplifier V201 is supplied from first rf agc rectifier V601B through J613-3, P113-3, P106-K, J206-K, agc filter resistor R202 (bypassed by capacitor C201), inductor L238 of tuning network Z204A, and the contacts of section 2 (rear) of switch S201. First rf agc rectifier V601B supplies agc voltage to V201 only. Separate agc is fed to V201 to minimize receiver blocking (para 20). Positive voltage is applied from RF GAIN SQUELCH THRESH potentiometer R105 through P106-F, J206-F, and inductor L207 to the cathode of V201. This variable bias voltage provides manual gain control for V201. Capacitor C223 is the cathode bypass capacitor. Potentiometer R105 also controls the gain of second rf amplifier V202 and first if. amplifier V501 (through P113-6 and J613-6); decoupling is provided by L207 and C224. The +28 volts is supplied to the plate and screen grid through function switch S104 and resistor R204. The plate voltage is applied through inductor L211 and the contacts of section 4 of switch S201. Capacitor C226 and resistor R204 prevent rf from entering the +28-volt line. Capacitor C225 is the screen-grid bypass capacitor. Resistor R106 and potentiometer R105 control the bias applied to the cathode of V201.

c. A calibration signal can be applied to the grid circuit of V201 through the floorplate contact and coupling capacitor C221. Test point E201 is an accessible connection to the grid circuit for testing.

d. Six-position band switch S201, which is operated by the MEGACYCLES control, selects one of the six tuning networks in the output circuit of the first rf amplifier. The frequency range of each tuning network is as follows: Z207, 0.5 to 1 mc; Z208, 1 to 2 mc; Z209, 2 to 4 mc; Z210, 4 to 8 mc; Z211, 8 to 16 mc; and Z212, 16 to 32 mc. The core in the inductor of each tuning network is moved by the MEGACYCLES and KILOCYCLES controls, except for the 0.5- to 1-mc and the 1- to 2-mc bands, in which the cores are moved by the KILOCYCLES control only.

6. Second Rf Amplifier V202
(fig. 3)

a. The signal from first rf amplifier V201 is applied through coupling capacitor C245 to the control grid of second rf amplifier V202. The amplified signal at the plate of V202 is fed through the contacts of section 6 of band switch S201 to tuning network Z216. Capacitors C259 and C260 are connected in series as a voltage-divider circuit. The signal takeoff at the junction of C259 and C260 reduces loading and minimizes detuning. The signal is then applied through section 7 of band switch S201 and coupling capacitor C267 to the grid of first mixer V203.

b. Agc voltage is applied to the grid of second rf amplifier V202, from rf and if. agc rectifier tube V602A, through J613-13, P113-13, P106-C, J206-C, resistor R206 and grid-return R205. Resistor R206 and capacitor C246 form an agc filter network. The cathode (pin 7) and suppressor grid (pin 2) are connected together and returned to ground through inductor L214,

J206-F, P106-F, and potentiometer R105. Inductor L214 and capacitor C224 decouple the cathode circuit from the first if. amplifier for rf. Capacitor C247 is the cathode bypass. RF GAIN SQUELCH THRESH control R105 is common to the first and second rf amplifier stages and the first if. amplifier stage. The +28 volts is obtained through function switch S104 and applied to the screen grid (pin 6) of V202 from function switch S104 and resistor R207. Plate voltage is applied from the screen grid of V202 through inductor L218 and the contacts on band switch S201, section 6. The screen grid is bypassed by capacitor C248; R207 is a screen and plate decoupling resistor.

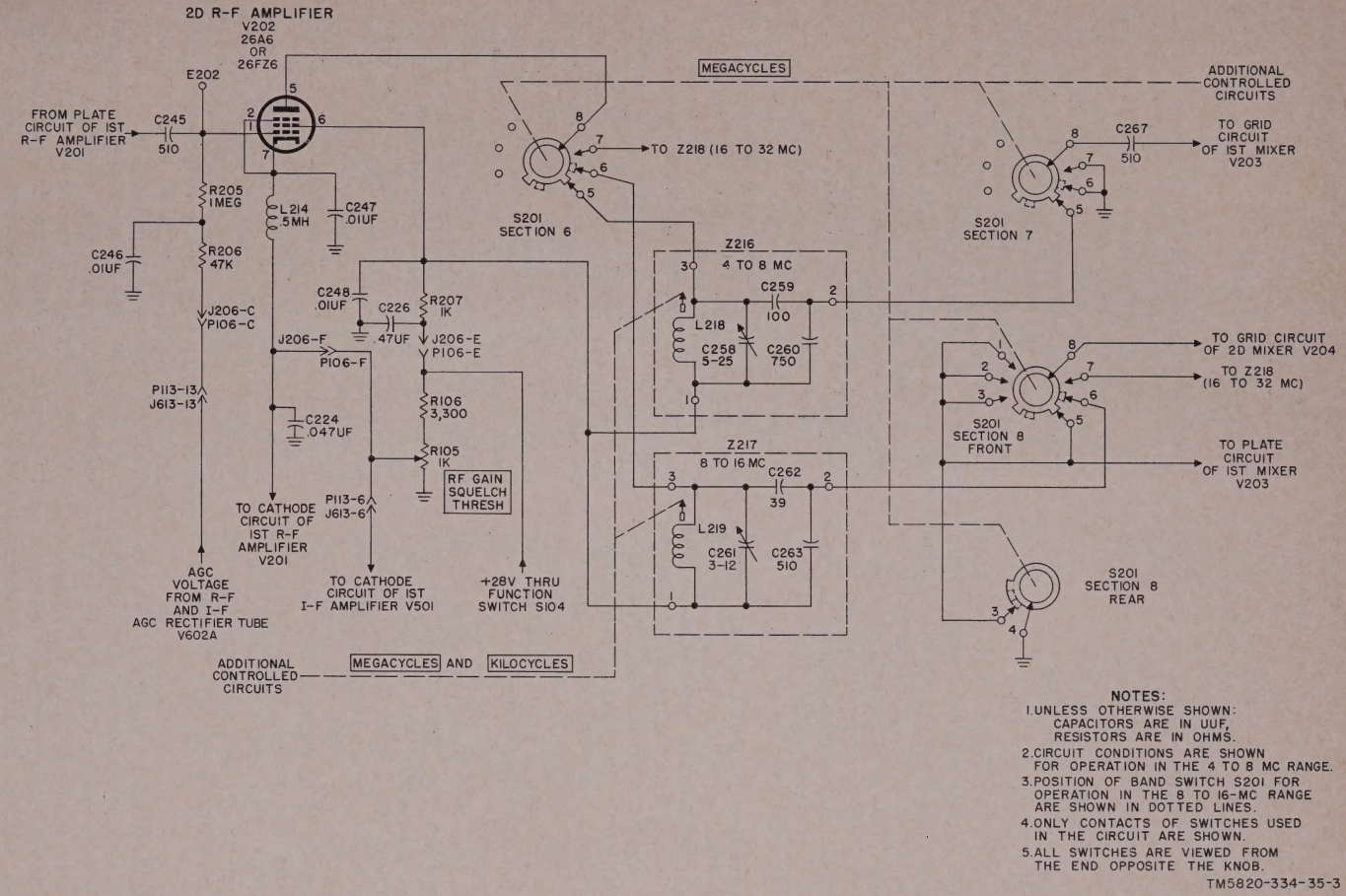
c. When the receiver operates within the 8- to 16-mc or 16- to 32-mc range, the first mixer is not used. Operation in the 8- to 16-mc range is shown by the broken lines of band switch S201. Operation in the 16- to 32-mc range is similar to that in the 8- to 16-mc range. The rf signal at the plate of the second amplifier is applied through the contacts (broken line) of section 6 of band switch S201 to tuning network Z217. Capacitor C262 and C263 form a voltage divider; only the portion of the voltage appearing across inductor L219 is applied through section 8 (front) of band switch S201 to the grid circuit of second mixer V204. The input to first mixer V203 is grounded through coupling capacitor C267 and section 7 of band switch S201. The output of first mixer V203 is grounded through section 8, rear, of band switch S201; thus, the tuning networks for frequencies between 0.5 and 8 mc are inoperative, when the 8- to 16-mc and 16- to 32-mc ranges are used.

d. Selection of the output circuit of the second rf amplifier is made by S201 which is operated by the MEGACYCLES control. The frequency range of each tuning network is as follows: Z213, 0.5 to 1 mc; Z214, 1 to 2 mc; Z215, 2 to 4 mc; Z216, 4 to 8 mc; Z217, 8 to 16 mc; and Z218, 16 to 32 mc. Triple conversion is used in the frequency range from 0.5 to 8 mc, and double conversion is used in the frequency range from 8 to 32 mc. Test point E202 provides an accessible connection to the grid for testing.

7. First Mixer V203 (fig. 4)

First mixer V203 uses a type 26C6 miniature triode tube. The second rf amplifier output is applied to the control grid (pin 1) and the output of first cyrstal oscillator V401 is applied to the cathode (pin 2). The two signals are heterodyned to produce a signal between 9 and 18 mc in the plate circuit. The frequency of the mixer output signal is variable, and is the sum of the frequencies of the two input signals. In the frequency range from 8 to 32 mc, the input and output of the first mixer are grounded. This is indicated in figure 4 by the broken lines of band switch S201.

a. The first mixer is used only over the 0.5- to 8-mc range. Throughout the 0.5- to 8-mc range, the signal voltage from second rf amplifier V202 is applied through section 7 of band switch S201 to the control grid of first mixer V203. The signal from first crystal oscillator V401 is at a fixed frequency for each band within the 0.5- to 8-mc range and is applied through T401, P402, J202, and resistor R209 (in parallel with capacitor C268) to the cathode of V203. The first mixer plate circuit is tuned by moving the powdered-iron cores within the inductors of Z219, Z220, and Z221. Capacitor C271, C296, C274, C297, and C277 provide fixed capacity for the tuning networks. Capacitors C270, C273, and C276 are trimmer capacitors. The output signal from first mixer V203 is applied from Z219 through C272 to Z220, from Z220 through C275 to Z221, from Z221 through C278 and section 8 (front) of band switch S201 to the grid of second mixer V204. In the 0.5- to 8-mc range, the front of section 8 of S201 connects the output of the first mixer to the second mixer; and in the 8- to 32-mc range, the front of section 8 of S201 connects the output of second rf amplifier V202 to the second mixer. The rear of section 8 of S201 grounds the output of the first mixer during operation within the 8- to 32-mc band (indicated by dotted lines on section 8 of S201).



NOTES:

1. UNLESS OTHERWISE SHOWN: CAPACITORS ARE IN UUF, RESISTORS ARE IN OHMS.
2. CIRCUIT CONDITIONS ARE SHOWN FOR OPERATION IN THE 4 TO 8 MC RANGE.
3. POSITION OF BAND SWITCH S201 FOR OPERATION IN THE 8 TO 16-MC RANGE ARE SHOWN IN DOTTED LINES.
4. ONLY CONTACTS OF SWITCHES USED IN THE CIRCUIT ARE SHOWN.
5. ALL SWITCHES ARE VIEWED FROM THE END OPPOSITE THE KNOB.

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Figure 3. Second rf amplifier, simplified schematic diagram.

b. Cathode bias is developed across resistor R209; capacitor C268 bypasses the rf signal around R209. The grid is returned to ground through grid resistor R208. The +28 volts is applied to the plate (pin 7) of first mixer V203 through function switch S104, P106-E, J206-E, decoupling resistor R210, and inductor L221. Decoupling resistor R210 is bypassed by capacitor C269.

8. First Crystal Oscillator V401
(fig. 5)

First crystal oscillator V401 provides the injection signal for first mixer V203 (fig. 4) on the eight lower-frequency bands. Figure 5 shows circuit operation on the 4- to 5-mc band. The first crystal oscillator uses a type 6AJ5 miniature pentode connected in an electron-coupled Colpitts circuit, with a crystal substituted for the conventional resonant circuit.

a. The oscillatory circuit consists of the cathode, control grid, and screen grid of tube V401; the screen grid acts as the oscillator anode. The control grid is connected to crystal Y405 through contact 4, section 1 of switch S401. The signal voltage feedback loop is from the screen grid (or anode) through capacitor C403 to ground and then to the control grid circuit; oscillations are sustained at the fundamental crystal frequency of 7 mc for the 4- to 5-mc band. The amplitude and stability of the oscillations are determined by the values of capacitors C401 and C402. The direct-current (dc) return for the cathode is inductor L401. Trimmer capacitor C408 and fixed capacitor C407 are connected, through contact 4 of section 2 of switch S401, across the primary of T401 and resonate T401. The output signal is transformer-coupled by T401 through P402 and J202 to the cathode of first mixer tube V203.

b. Resistor R401 is the grid-leak resistor. The +28 volts for the screen grid and the plate is applied through function switch S104, P106-B, J206-B, J201-A, P401-A, and decoupling resistor R402 and to the plate through the primary winding of T401. The screen grid is bypassed by capacitor C403.

9. Second Mixer V204
(fig. 6)

Second mixer V204 uses a type 26C6 miniature triode tube. Signals from first mixer V203 (fig. 4) (or second rf amplifier V202 (fig. 3) on the 8- to 32-mc range) are applied to the grid of second mixer V204. The output of second crystal oscillator V402 is injected at the V204 cathode. The two signals heterodyne to produce a signal within the range of 3 to 2 mc on all bands except the 0.5- to 1-mc band. On the 0.5- to 1-mc band, the mixer output signal is 2.5 to 2 mc. The mixer output signal is the difference frequency between the signal of the grid and the oscillator signal at the cathode.

a. The second mixer functions on all bands. Signals from either the first mixer or the second rf amplifier are applied to the grid of V204. The injection signal from second crystal oscillator V402 is applied to the mixer cathode through T402, P403, J203, and resistor R212 (in parallel with capacitor C279). The tuning networks in the plate are Z222, Z223, and Z224. The signal from the mixer plate is applied from Z222, through C283, to Z223, from Z223 through C286, to Z224, from Z224 through P208 and J808 to the grid (pin 7) of vfo-mixer V801. Capacitor C289 across Z222 and C298 across Z223 minimize the effects of the stray circuit capacitance across Z222 and Z223, respectively. The plate circuit is tuned to resonance by positioning the powdered-iron cores in inductors L224 of Z222, L225 of Z223, and L226 of Z224. The parallel combination of fixed capacitors C289 and C282 and trimmer C281 resonate inductor L224; the parallel combination of fixed capacitor C298 and C285 and trimmer C284 resonate inductor L225; capacitor C288 in parallel with trimmer C287 resonate inductor L226.

b. Cathode bias is developed across resistor R212, bypassed by capacitor C279. The B+ voltage is applied to the plate through function switch S104 through P106-E, J206-E, resistor R213, and

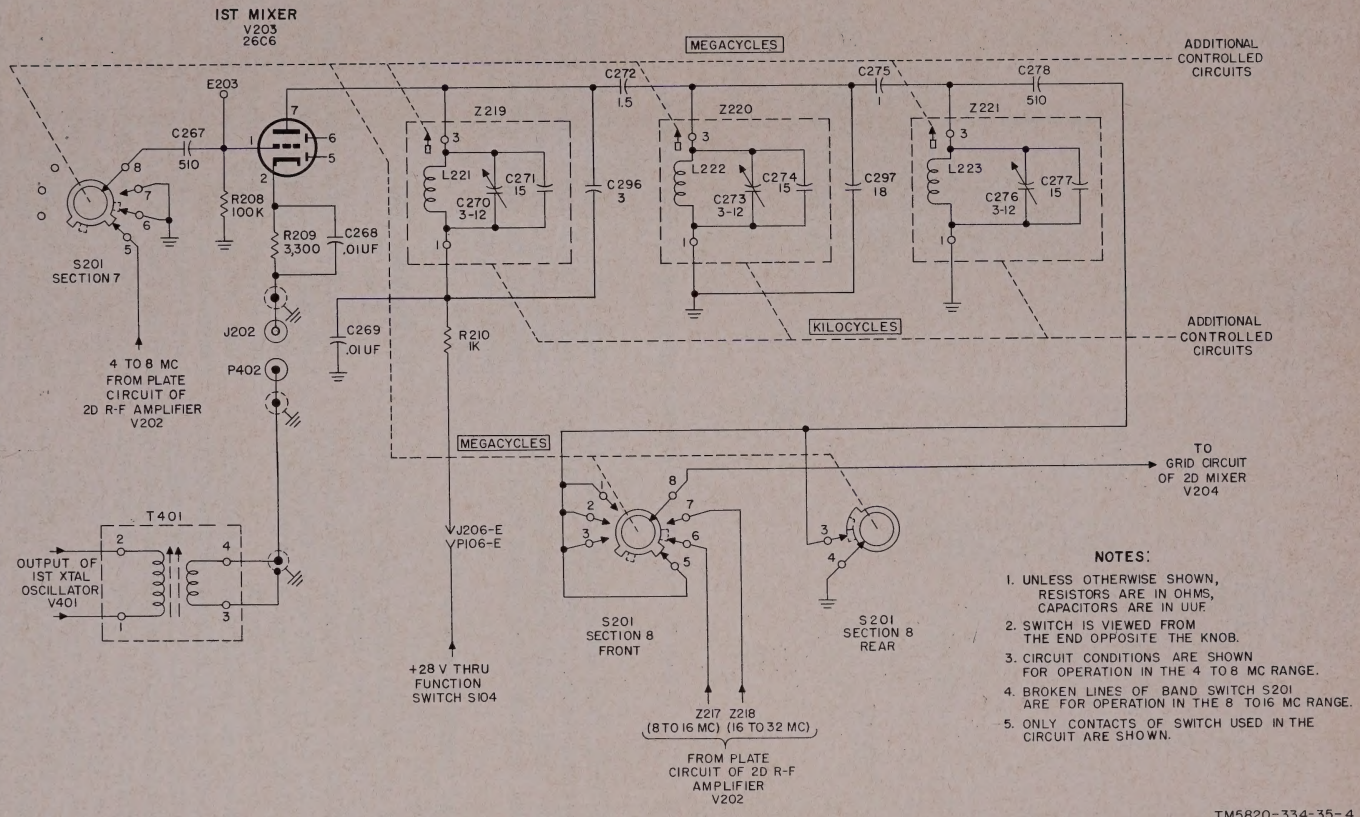


Figure 4. First mixer stage, simplified schematic diagram.

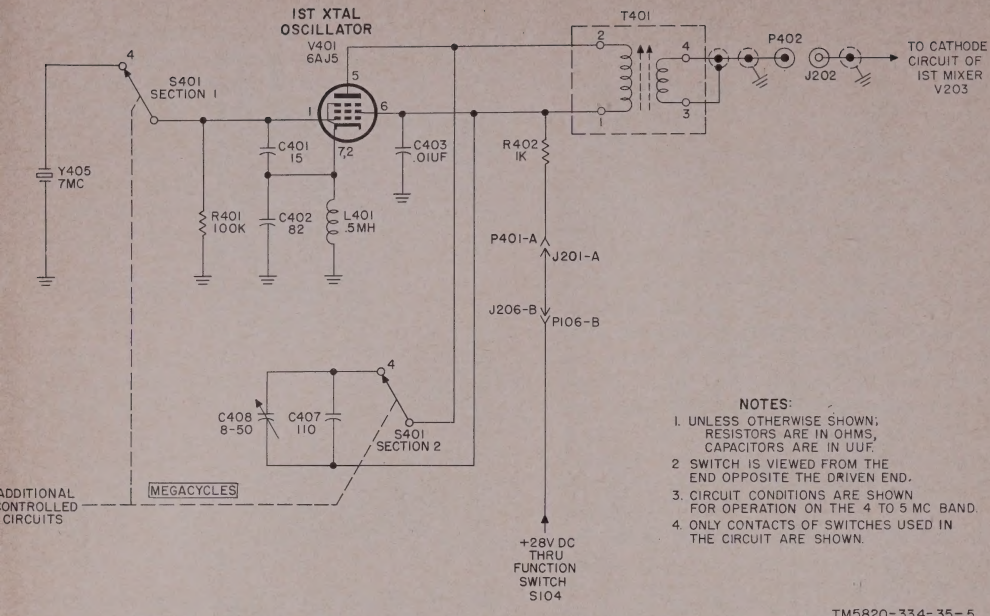


Figure 5. First crystal oscillator, simplified schematic diagram.

inductor L224. Decoupling in the plate circuit is accomplished by resistor R213 and capacitor C280. Grid voltage measurements can be made at test point E204.

10. Second Crystal Oscillator V402 (fig. 7)

Second cyrstal oscillator V402 provides oscillator injection signals for second mixer V204 on all 32 bands. Operation on the 4-5 mc band is shown in the figure. The oscillator uses a type 6AJ5 miniature pentode in a Colpitts circuit.

a. The second crystal oscillator is identical in construction and operation with the first crystal oscillator. The stage analysis of the second crystal oscillator is the same as the stage analysis of the first crystal oscillator (para 8) except for the difference in reference symbols.

b. The MEGACYCLES control operates switch S401. On the 4- to 5-mc band, contact 4, section 4 of switch S401 connects Y409 (14-mc fundamental frequency) to the control grid and contact 4, section 3 of switch S401 connects capacitors C421 and C420 into the plate circuit to obtain maximum output at the crystal resonant frequency.

11. Vfo-Mixer V801 (fig. 8)

Vfo-mixer V801 uses a type 26D6 miniature tube, connected as a pentagrid converter. Signals from second mixer V204 are applied to the mixer grid (pin 7) of V801 and are heterodyned with the signal generated in the vfo section of V801 to produce an output signal at the plate (pin 5) of 455 kc. The vfo section of V801, connected as a Hartley oscillator, comprises the cathode (pin 2), the oscillator grid (pin 1), and the screen grid (pin 6), which acts as the oscillator anode. Feedback to sustain oscillation in the vfo section is obtained by connecting the cathode to a tap on inductor

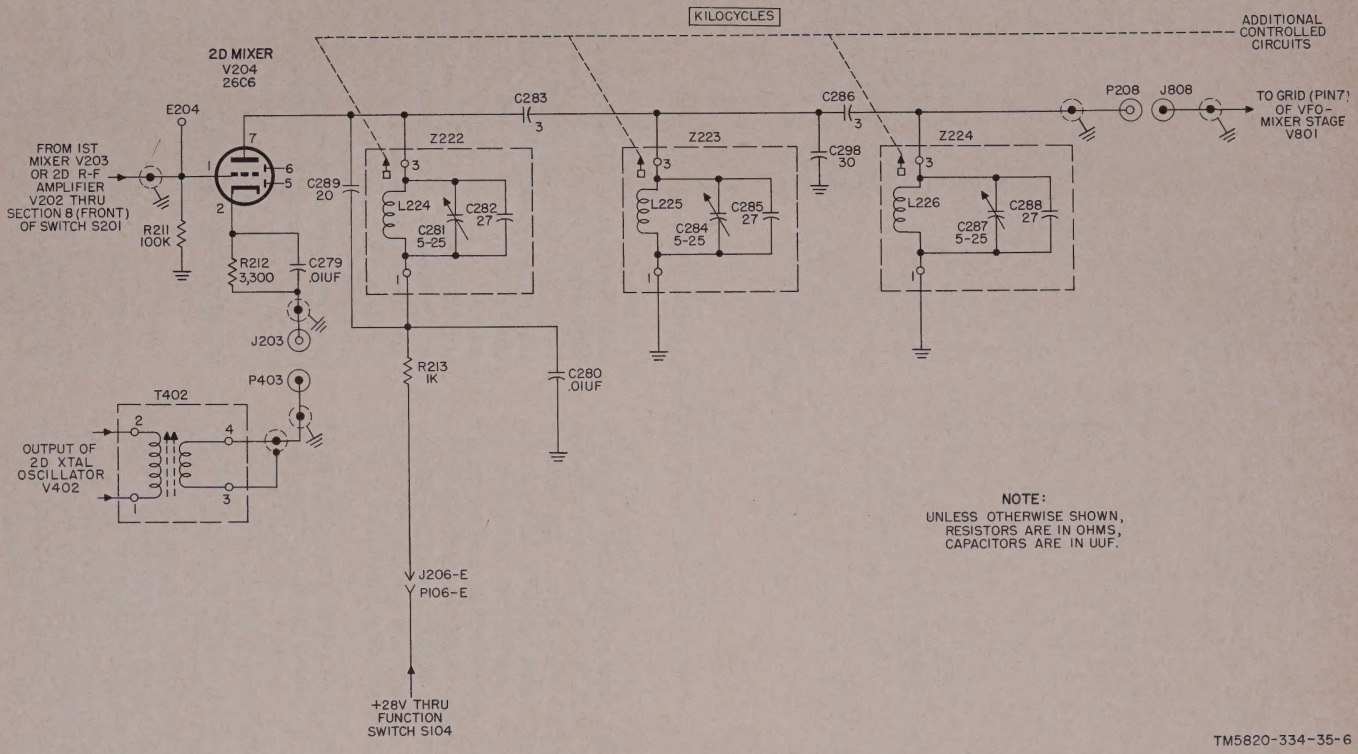


Figure 6. Second mixer V204, simplified schematic diagram.

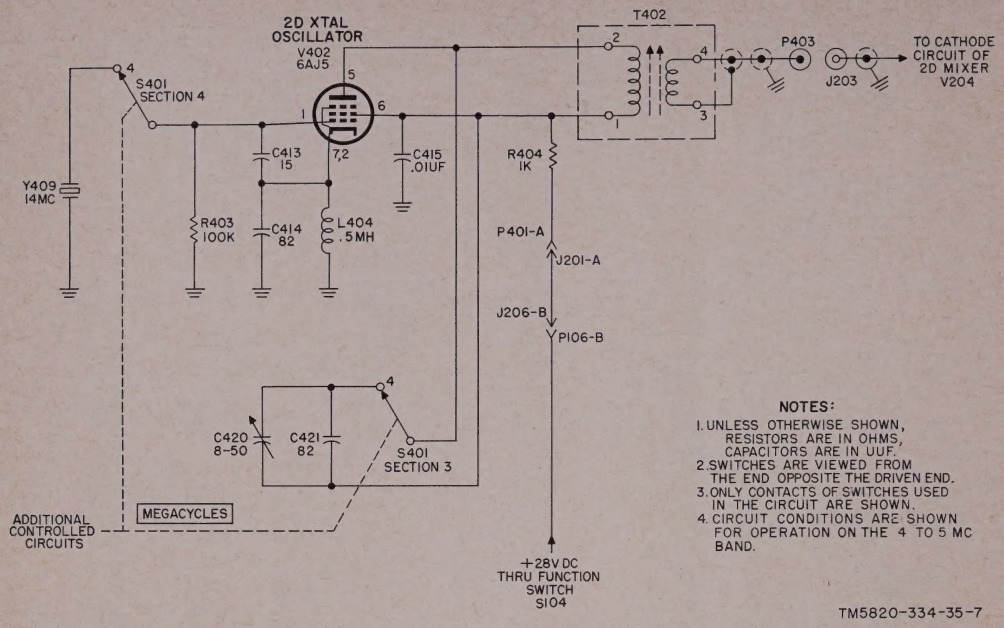


Figure 7. Second crystal oscillator, simplified schematic diagram.

L802 in tuning unit Z801 and coupling energy to the grid (pin 1) through capacitor C804. The screen grid is maintained at rf ground potential by C805. The screen grid minimizes undesired coupling by shielding the oscillator grid from the mixer grid. The suppressor connects to the cathode. The 455-kc signal selected at the plate is the difference of the incoming signal frequency and the oscillator signal frequency.

a. Capacitor C804 and resistor R801 provide grid-leak bias for the vfo section of V801. The +28-volts is applied through function switch S104, P109-F, J809-F, and L803 to the screen grid (pin 6) and through the primary winding of T801 to the plate (pin 5). Inductor L803 and capacitor C805 form a decoupling filter to prevent rf current from entering the +28-volt line.

b. The output signal of second mixer V204, applied through P208 and J808 to the mixer grid (pin 7), and the signal at the oscillator grid (pin 1) heterodyne to produce a signal at 455 kc in the plate circuit. This signal appears across the primary of T801, and induces a signal in the secondary; transformer T801 is tuned to 455 kc. The T801 output is applied through P810 and J510 to the grid circuit of first if. amplifier V501. Resistor R802 broadens the frequency response of T801.

c. Tuning unit Z801 includes capacitors C801, C802, and C803 connected across inductors L801 and L802. The capacitors have the proper temperature coefficients to achieve a high degree of frequency stability.

12. 455-kc If. Amplifiers (fig. 9, 10, and 11)

The if. amplifier section consists of six voltage-amplifier stages, which use type 26A6 miniature pentode tubes, V501 through V506. The output of fifth if. amplifier V505 supplies a 455-kc signal to sixth if. amplifier V506 and agc if. amplifier

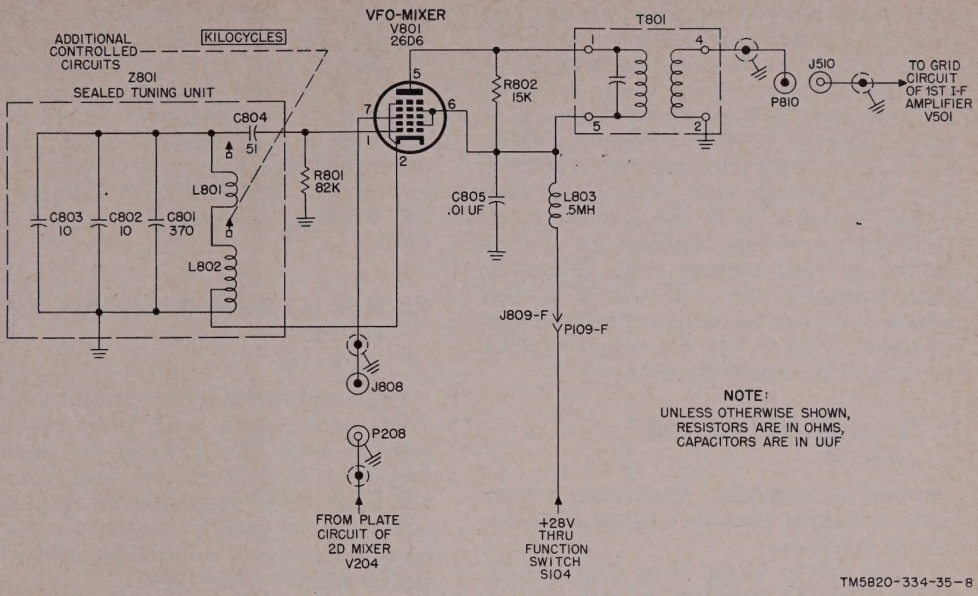


Figure 8. Vfo-mixer, simplified schematic diagram.

V609. The output signal of the sixth if. amplifier is demodulated (detected) in detector V603A. The gain of the if. amplifier section is controlled manually by the RF GAIN SQUELCH THRESH control and automatically by the agc circuits when the AGC switch is set to ON or CAL. To prevent oscillations that may occur from coupling between if. stages through the common impedance of the power source, decoupling networks are used in the screen grid and plate circuits of all if. amplifier stages. Three degrees of selectivity (2, 4, or 8 kc) are obtained by varying the coupling between the primary and secondary windings of the if. transformers with tertiary windings connected into the circuit by the BAND WIDTH switch.

13. First If. Amplifier V501 (fig. 9)

First if. amplifier V501 uses a type 26A6 miniature pentode tube as a 455-kc voltage amplifier.

a. The 455-kc signal from vfo-mixer V801 is coupled through P810, J510, and capacitor C501 to the control grid (pin 1) of first if. amplifier V501; the signal voltage is developed across grid-return resistor R501. The V501 amplified output signal develops across the tuned primary of transformer T501 and is inductively coupled to the tuned secondary for application to second if. amplifier V502.

b. A particular degree of selectivity is obtained by connecting a winding of transformer T501 through the contacts of section 1 of BAND WIDTH switch S501. Series resistor R504 provides proper bandwidth in the 8 KC position of S501.

c. Agc voltage from rf and if. agc rectifier V602A is applied to the grid (pin 1) through resistor R502 and grid resistor R501. Resistor R502 and capacitor C502 form a grid decoupling filter. The gain of the stage is manually controlled by varying the cathode bias with RF GAIN SQUELCH THRESH control R105. Cathode bias is applied through P113-6, J613-6, and L531;

C503 is the cathode bypass capacitor. The +28 volts is applied through function switch S104, P113-19, J613-19 and resistors R624 and R506 to the screen grid (pin 6) and to the plate (pin 5) through the primary of T501. Resistor R506 and capacitor C506 and resistor R624 and capacitor C714 form plate and screen-grid decoupling networks. Resistor R106 and potentiometer R105 form a voltage divider for manual control of V501 cathode bias. Capacitor C624 bypasses the +28-volt line. The capacitor across the primary of T501 and capacitor C505 in the secondary of T501 are part of the tuned circuits.

14. Second If. Amplifier V502 (fig. 9)

Second if. amplifier V502 uses a type 26A6 miniature pentode tube as a 455-kc voltage amplifier.

a. The 455-kc signal from first if. amplifier V501 is coupled through transformer T501 and capacitor C507 to the control grid of second if. amplifier V502; the signal voltage is developed across grid-return resistor R507. The output signal is developed across the tuned primary of transformer T502 and coupled to the tuned secondary for application to the grid circuit of third if. amplifier V503.

b. Agc voltage from rf and if. agc rectifier V602A is applied to the grid through resistors R508 and R507; R508 and C508 form a grid decoupling network. Cathode bias is developed across resistor R509, which is bypassed for rf by capacitor C509. Inductor L506 prevents if. signals from flowing through CARRIER LEVEL meter M101. The suppressor grid is at ground potential. The +28 volts is applied to the screen grid from the junction of R624 and R506 through decoupling resistor R512; capacitor C512 is the screen-grid bypass capacitor. The plate circuit is completed through the primary winding of T502. The voltage across R509 is applied through L506, J613-7 and P113-7, to one side of CARRIER LEVEL meter M101. The voltage between the arm of R662 and ground is applied through J613-10, P113-10, to the other side of M101. Resistor R621 and meter zero resistor R622 for a voltage divider. The CARRIER LEVEL meter circuit is discussed in detail in paragraph 21.

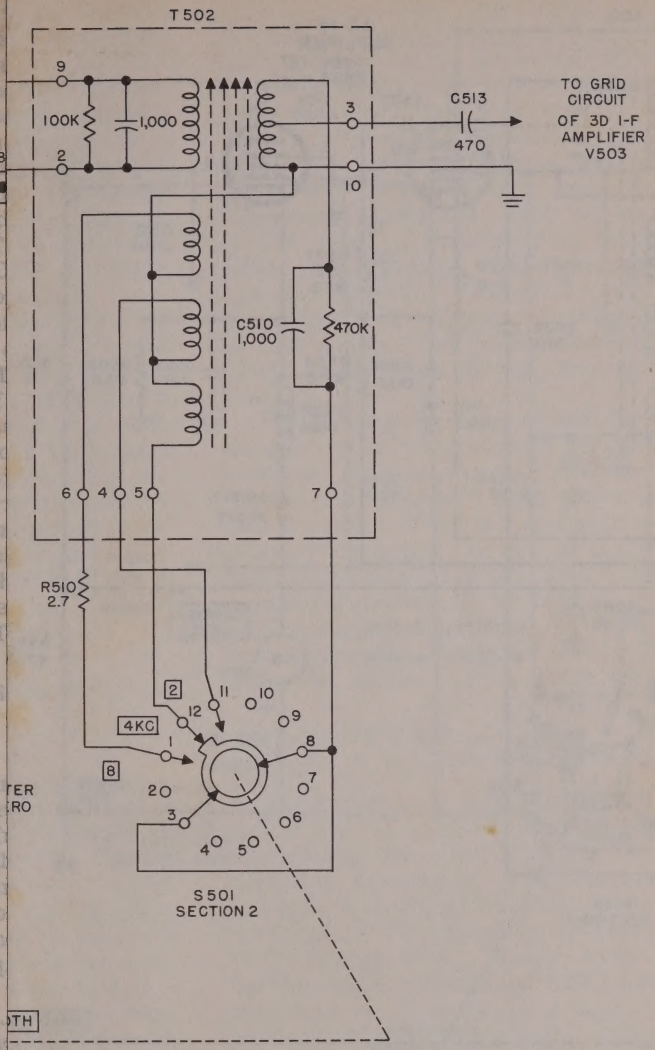
c. A particular degree of selectivity is obtained by the connection of one of thee windings in transformer T502, through the contacts of section 2 of BAND WIDTH switch S501. Resistor R510, in series with one winding, provides the required bandwidth.

15. Third and Fourth If. Amplifiers V503 and V504 (fig. 10)

Third and fourth if. amplifiers V503 and V504 each use a type 26A6 miniature pentode tube. The gains of the third and fourth if. amplifiers are low. Third if. amplifier V503 maintains the gain of the overall if. amplifier constant for the different degrees of selectivity chosen with BAND WIDTH switch S501.

a. The 455-kc signal is coupled to the control grid of third if. amplifier V503 from second if. amplifier V502 through capacitor C513; the signal voltage is developed across grid resistor R513. The amplified output signal appears across the tuned primary of transformer T503. The signal induced into the secondary of T503 is coupled to the control grid of V504 through capacitor C518; the signal voltage is developed across grid resistor R520. The amplified signal at the plate of V504 is applied through tuned transformer T504 and capacitor C523 to the control grid of fifth if. amplifier V505.

b. To keep the gain of the overall if. amplifier constant, cathode bias for V503 is changed for different positions of BAND WIDTH switch S501. Resistors R517, R518, and R519 are connected through section 3 of BAND WIDTH switch S501 to the cathode (pin 7) of V503 and change the bias for different switch positions. Cathode bias for V504 is developed across fixed resistor R533 in series with variable resistor R521. The suppressor grids are connected to ground. The +28 volts is applied to the screen grids through function switch S104 and a common circuit that


T502
9
100K
1,000
2
P8
FROM VFO MIXER V801
3
C513
470
TO GRID CIRCUIT OF 3D I-F AMPLIFIER V503
10
C510 1,000
470K
6
4
5
7
R510 2.7
2
11
10
12
9
4KC
1
8
8
20
7
3
6
4
5
S501 SECTION 2

C503 is the cathode bypass capacitor. The +28 volts is applied through function switch S104, P113-19, J613-19 and resistors R624 and R506 to the screen grid (pin 6) and to the plate (pin 5) through the primary of T501. Resistor R506 and capacitor C506 and resistor R624 and capacitor C714 form plate and screen-grid decoupling networks. Resistor R106 and potentiometer R105 form a voltage divider for manual control of V501 cathode bias. Capacitor C624 bypasses the +28-volt line. The capacitor across the primary of T501 and capacitor C505 in the secondary of T501 are part of the tuned circuits.

14. Second If. Amplifier V502
(fig. 9)

Second if. amplifier V502 uses a type 26A6 miniature pentode tube as a 455-kc voltage amplifier.

a. The 455-kc signal from first if. amplifier V501 is coupled through transformer T501 and capacitor C507 to the control grid of second if. amplifier V502; the signal voltage is developed across grid-return resistor R507. The output signal is developed across the tuned primary of transformer T502 and coupled to the tuned secondary for application to the grid circuit of third if. amplifier V503.

b. Agc voltage from rf and if. agc rectifier V602A is applied to the grid through resistors R508 and R507; R508 and C508 form a grid decoupling network. Cathode bias is developed across resistor R509, which is bypassed for rf by capacitor C509. Inductor L506 prevents if. signals from flowing through CARRIER LEVEL meter M101. The suppressor grid is at ground potential. The +28 volts is applied to the screen grid from the junction of R624 and R506 through decoupling resistor R512; capacitor C512 is the screen-grid bypass capacitor. The plate circuit is completed through the primary winding of T502. The voltage across R509 is applied through L506, J613-7 and P113-7, to one side of CARRIER LEVEL meter M101. The voltage between the arm of R662 and ground is applied through J613-10, P113-10, to the other side of M101. Resistor R621 and meter zero resistor R622 for a voltage divider. The CARRIER LEVEL meter circuit is discussed in detail in paragraph 21.

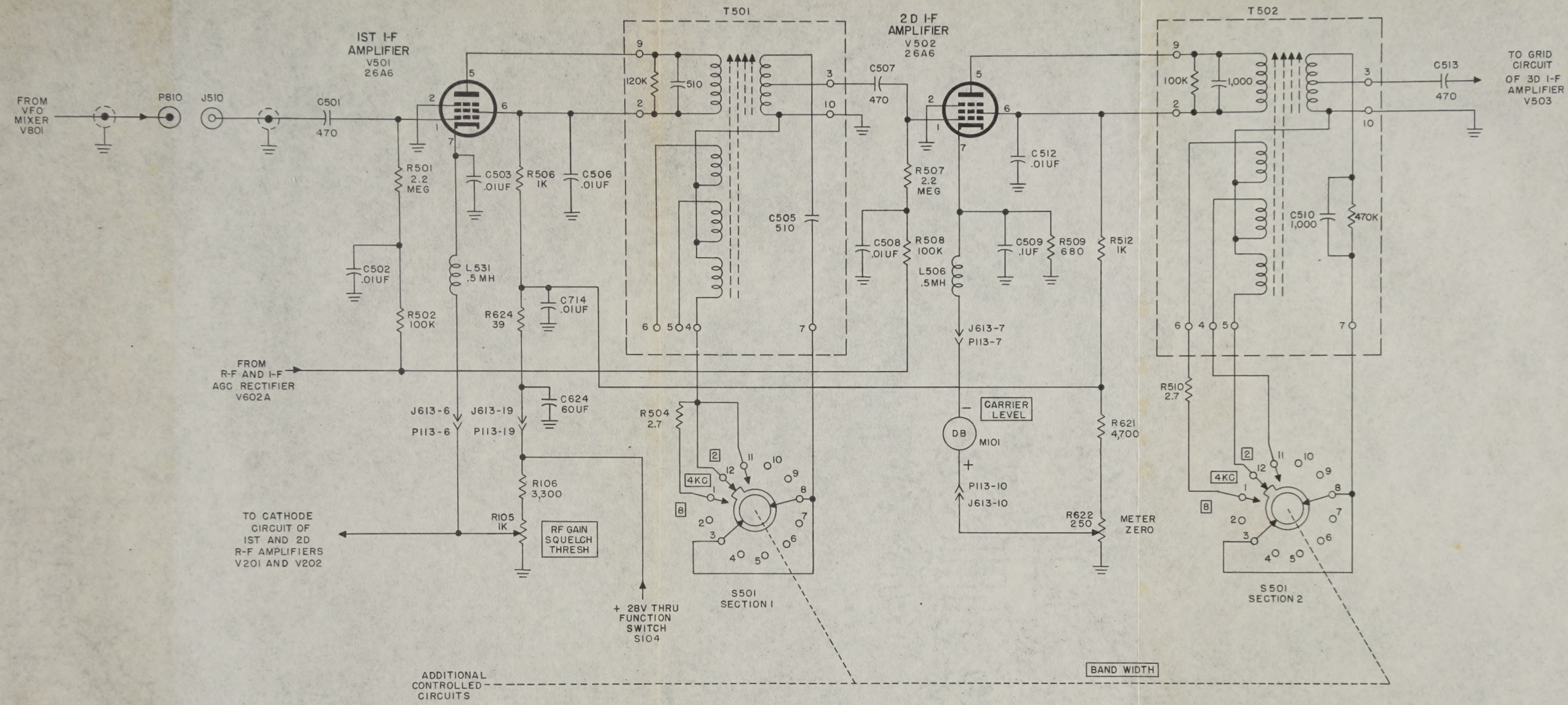
c. A particular degree of selectivity is obtained by the connection of one of thee windings in transformer T502, through the contacts of section 2 of BAND WIDTH switch S501. Resistor R510, in series with one winding, provides the required bandwidth.

15. Third and Fourth If. Amplifiers V503 and V504
(fig. 10)

Third and fourth if. amplifiers V503 and V504 each use a type 26A6 miniature pentode tube. The gains of the third and fourth if. amplifiers are low. Third if. amplifier V503 maintains the gain of the overall if. amplifier constant for the different degrees of selectivity chosen with BAND WIDTH switch S501.

a. The 455-kc signal is coupled to the control grid of third if. amplifier V503 from second if. amplifier V502 through capacitor C513; the signal voltage is developed across grid resistor R513. The amplified output signal appears across the tuned primary of transformer T503. The signal induced into the secondary of T503 is coupled to the control grid of V504 through capacitor C518; the signal voltage is developed across grid resistor R520. The amplified signal at the plate of V504 is applied through tuned transformer T504 and capacitor C523 to the control grid of fifth if. amplifier V505.

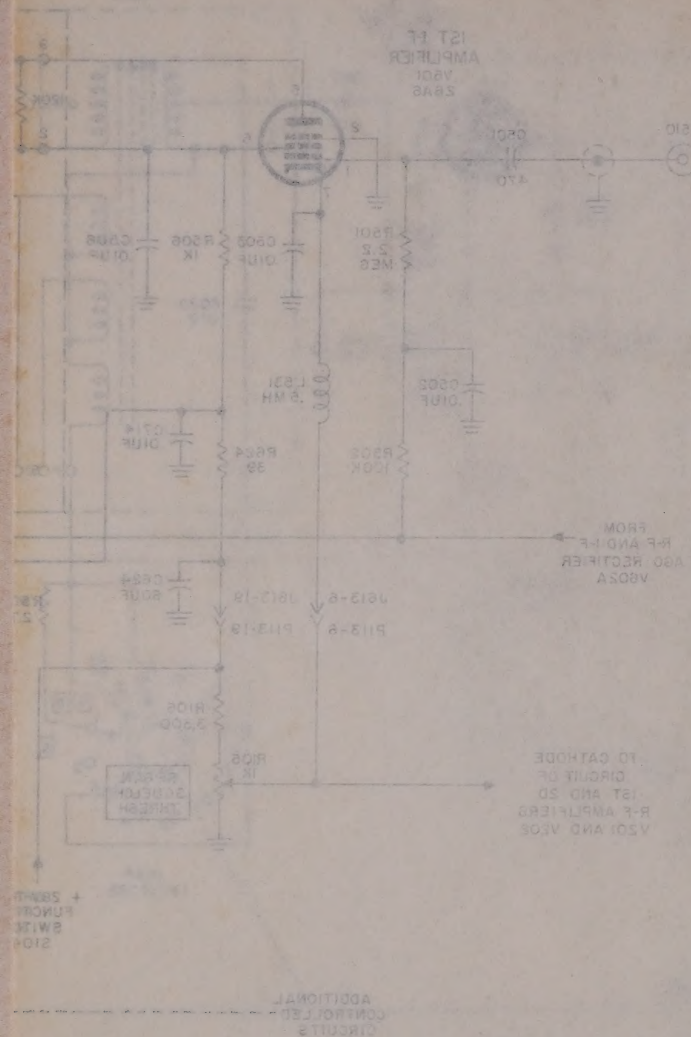
b. To keep the gain of the overall if. amplifier constant, cathode bias for V503 is changed for different positions of BAND WIDTH switch S501. Resistors R517, R518, and R519 are connected through section 3 of BAND WIDTH switch S501 to the cathode (pin 7) of V503 and change the bias for different switch positions. Cathode bias for V504 is developed across fixed resistor R533 in series with variable resistor R521. The suppressor grids are connected to ground. The +28 volts is applied to the screen grids through function switch S104 and a common circuit that



NOTES:

1. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2. BAND WIDTH SWITCH S501 IS SHOWN IN THE 4KC POSITION.
3. SWITCHES ARE VIEWED FROM THE END OPPOSITE THE DRIVEN END.

Figure 9. First and second if. amplifiers V501 and V502, simplified schematic diagram.


1ST RF
AMPLIFIER
V501
6BA6
FROM
R-F AMPLIFIER
A90 RECTIFIER
V802A
TO CATHODE
CIRCUIT OF
1ST AND 2D
R-F AMPLIFIERS
V201 AND V202
ADDITIONAL
CONTROLLED
CIRCUITS

comprises P113-19, J613-19, and decoupling resistor R624, which is bypassed by C714. Capacitor C624 bypasses the +28-volt line. The +28 volts is then applied through decoupling resistor R516 to the screen grid of V503, and through decoupling resistor R524 to the screen grid of V504. The +28 volts is applied to the plate (pin 5) circuits of V503 and V504 through the primary windings of T503 and T504, respectively. Capacitors C517 and C522 are screen-grid bypass capacitors.

c. A particular degree of selectivity is obtained by the connection of one of three windings in transformers T503 and T504, through sections 4 and 5 of BAND WIDTH switch S501. A small capacitor in each primary and secondary circuit forms part of the double-tuned transformer. The resistors across the transformer primaries and secondaries affect the required bandwidth. One winding in each transformer has a series resistor which affects bandwidth. Resistor R514 is used for T503 and resistor R522 is used for T504.

16. Fifth and Sixth If. Amplifiers V505 and V506
(fig. 11)

The fifth and sixth if. amplifier stages use type 26A6 miniature pentode tubes.

a. The 455-kc signal from fourth if. amplifier V504 is coupled through coupling capacitor C523 to the control grid of fifth if. amplifier V505. The output signal is developed across the tuned primary of transformer T505 and coupled to the tuned secondary. The signal is then coupled to the control grid of sixth if. amplifier V506 through capacitor C527; the signal voltage is developed across grid resistor R529. (The signal is also applied through capacitor C631 to the grid circuit of agc if. amplifier V609.) The V506 output signal is developed across tuned inductor L602 of T601 and coupled to inductor L603 through capacitor C602. The output of T601 is applied to the cathode circuit of detector V603A.

b. Adjustable cathode bias for V505 is provided by variable resistor R532 in the V505 cathode return; capacitor C530 bypasses the cathode. The cathode of V506 is returned directly to ground; grid-leak bias develops across R529. The +28 volts for both amplifiers is applied through function switch S104, through P113-19, J613-19, decoupling resistor R624, and decoupling resistors R528 and R531 to the screens of V505 and V506, respectively; capacitors C526 and C529 bypass the screen grids, capacitor C714 bypasses R624, and capacitor C624 bypasses the +28-volt line. The V505 plate circuit is completed to +28 volts through the primary of T505 and the V506 plate circuit is completed to +28 volts through the indicator L602.

c. A particular degree of selectivity is obtained by the connection of one of three windings in transformer T505 through section 6 of BAND WIDTH switch S501. The primary of T505 is tuned by the small shunting capacitor and the secondary is tuned by capacitor C525. The resistors across the transformer primary and secondary windings affect the interstage coupling bandwidth. Resistor R526 affects bandwidth in the 8 KC position of S501.

17. Bandwidth Selection Circuits
(fig. 9, 10, and 11)

a. The bandwidth of the overall if. amplifier can be varied in three steps (2, 4 and 8 kc) by the BAND WIDTH switch. The different bandwidths are obtained by changing the mutual coupling between the windings of the interstage transformers (T501 through T505). Mutual coupling in the transformers is changed with additional inductors wound on the same forms as the primary and secondary windings. The three additional inductors in each if. transformer aid or oppose (depending on how they are connected) the mutual coupling between the primary and secondary of the transformer. An increase in mutual coupling broadens the bandwidth; a decrease in mutual coupling narrows the bandwidth. The inductors nearest the secondary windings, as shown schematically, are most effective in obtaining the widest bandwidth; these inductors are connected phase opposing. One inductor at a time is connected

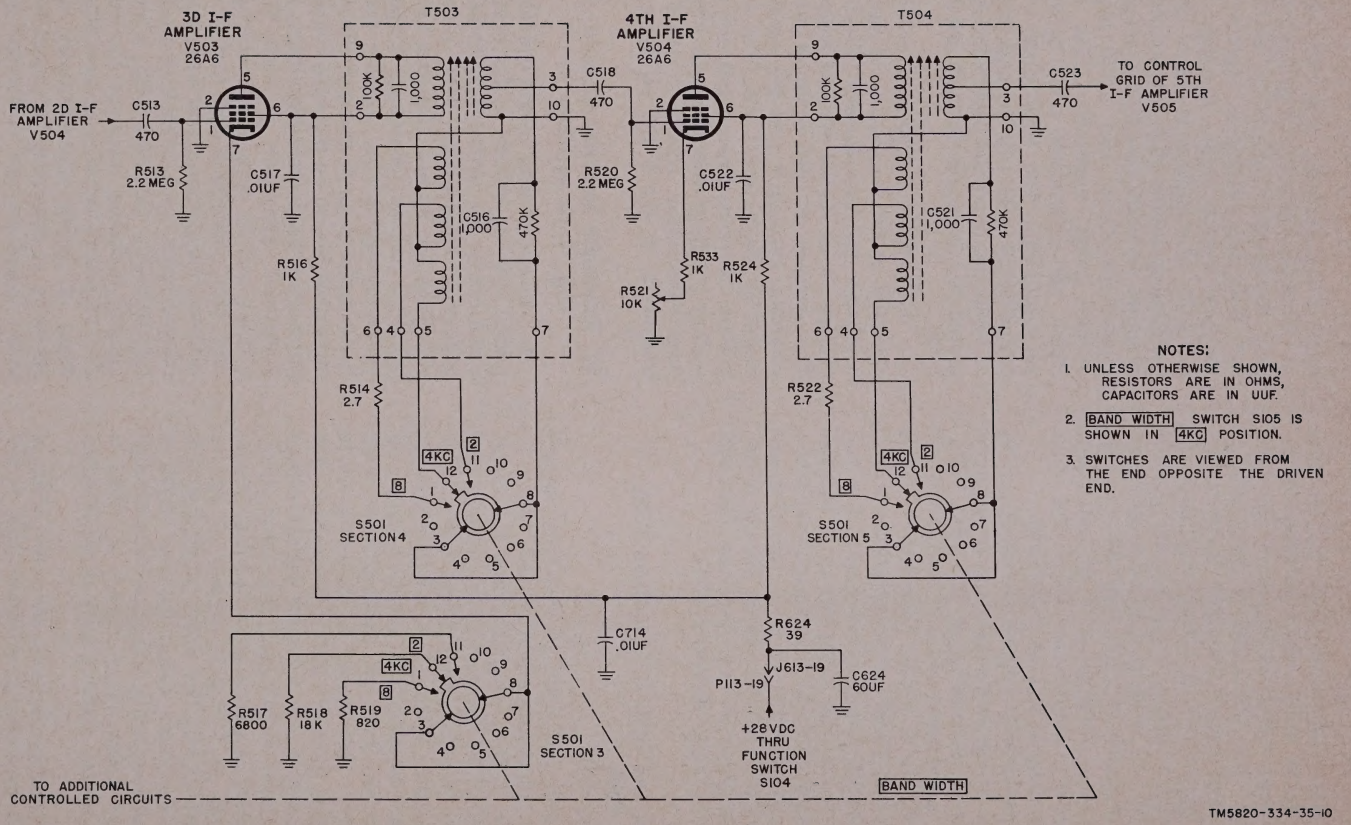


Figure 10. Third and fourth if. amplifiers V503 and V504, simplified schematic diagram.

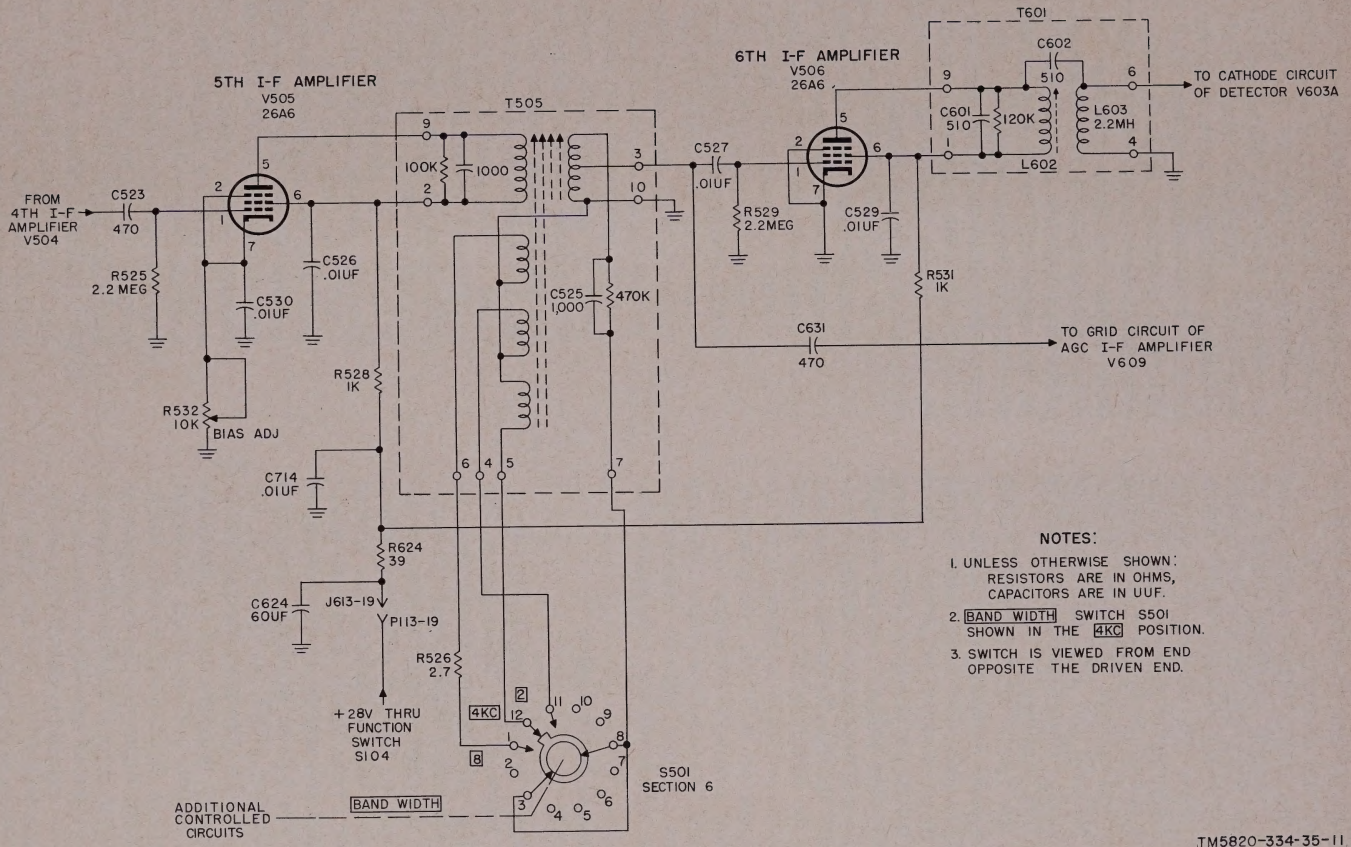


Figure 11. Fifth and sixth if. amplifiers V505 and V506, simplified schematic diagram.

in each transformer to produce a given degree of mutual coupling.

b. When the BAND WIDTH switch is set to 2 KC, a single coupling inductor of transformer T501 (fig. 9) and the middle inductors in transformers T502, T503, T504, and T505 are connected in series with the transformer secondaries. These middle inductors are in a phase-opposing connection and provide the sharpest selectivity, because the smallest degree of mutual coupling exists between the primary and secondary windings.

c. When the BAND WIDTH switch is set to 4 KC, mutual coupling in transformer T501 is unchanged. The inductors farthest from the primary windings of T502, T503, T504, and T505 are placed in phase-aiding connections. The mutual coupling between the primary and secondary windings is increased and the bandwidth is broadened.

d. When the BAND WIDTH switch is set to 8 KC, resistor R504 is added in series with the inductor in T501. The inductors nearest the primary windings of T502 through T505 are placed in phase-opposing connections. These circuit connections provide the relatively flat 8-kc bandwidth.

18. Detector and Noise Limiter (fig. 12)

The detector demodulates the 455-kc if. signal to recover the intelligence. The noise limiter minimizes interference by removing excessive noise peaks. The output of the detector is applied through the noise limiter to first af amplifier V606.

a. Detector V603A. Detector V603A uses half of a type 12AU7 miniature dual-triode tube connected as a half-wave diode rectifier. The 455-kc if. signal developed across inductor L603 is applied to the cathode of V603A. Diode-connected V603A conducts during negative half cycles of the applied if. signal and develops the audio voltage across diode-load resistor R605; capacitor C606 bypasses the rf component in the detector output. With the BFO switch at ON, the output of beat-frequency oscillator V604 is coupled to the V603A cathode through capacitor C618. The bfo signal is mixed in V603A with the if. input signal and produces an audiofrequency beat note across R605. Jack J615 is a test point.

b. Noise Limiter V603B. The noise limiter circuit uses one triode section of a type 12AU7 miniature dual-triode tube, connected as a diode series limiter. With section 2 of function switch S104 in the LIMITER position, noise limiter V603B eliminates peak noise voltages from the audio signal fed from detector V603A to first af amplifier V606. Although noise peaks are generally 10 to 20 times as great as the incoming radio signal, they are normally of short duration. The high-amplitude, short-duration pulses cut off noise limiter V603B and are removed from the audio signal applied to V606 with no noticeable loss in intelligence.

(1) The demodulated signal across resistor R605 is a composite of a negative average dc voltage and the audio component. The cathode of V603B is connected to R605 through resistors R612 and R611. Capacitor C609 couples the audio component to the plate and grid of diode-connected V603B; an audio voltage develops across resistor R608. With V603B connected as above, the plate is positive with respect to the cathode for the full audio signal and the noise limiter diode conducts. Continuous conduction maintains a low plate-to-cathode resistance of V603B and the complete audio component is coupled through capacitor C610, J613-8, and P113-8 to first af amplifier V606. At a function switch setting other than LIMITER, both the audio component and the negative average dc voltage across R605 are applied to the cathode of V603B. Thus, strong negative noise peaks (noise voltages developed across R605 are negative with respect to ground) maintain V603B conduction and are coupled through C610 to first af amplifier V606.

(2) When function switch S104 is set to LIMITER, capacitor C611 is connected between the junction of resistors R611 and R612 and ground

through J613-5, P113-5, and contacts 10 and 7 of S104. Capacitor C611 is charged through resistor R611 to the negative average dc voltage across R605; this voltage is applied to the cathode of V603B. Since the time constant of the network is long compared with the duration of the noise signal peaks, a noise peak causes no appreciable change in the voltage across capacitor C611. The negative noise peaks are coupled to V603B (as part of the audio component) through capacitor C609 and drive the plate more negative than the cathode (since the cathode does not change appreciably for the noise peak duration) and the tube is cut off. This action effectively removes the coupling to first af amplifier V606 for the duration of each noise peak.

19. Beat-Frequency Oscillator V604 (fig. 13)

A beat-frequency oscillator facilitates accurate tuning and permits the reception of radiotelegraph (cw) signals. When BFO switch S102 is at ON, beat frequency oscillator V604 generates a signal which is mixed with the 455-kc if. signal detector V603A. The mixing action produces an audible beat note in the output of the receiver. The bfo uses a type 26A6 miniature pentode tube connected as an electron-coupled Hartley oscillator.

a. The screen grid of V604 acts as the anode for the oscillator. The control grid is coupled through grid-leak capacitor C615 to the tuned circuit in T602, which consists of inductor L605 and parallel-connected capacitors C612, C613, and C614; capacitor C616 provides additional capacitance external to T602. The

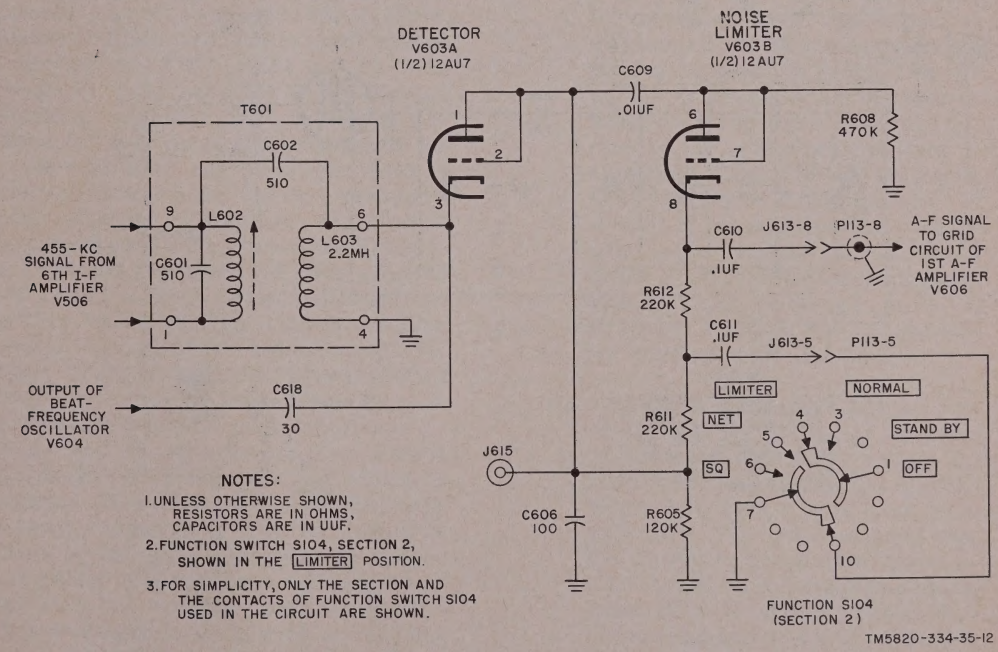


Figure 12. Detector and noise limiter, simplified schematic diagram.

capacitors have the correct temperature coefficient to assure frequency stability over a wide range of temperatures. The cathode of V604 is connected to a tap on the inductor. The output of V604 is coupled through capacitor C618 to the cathode circuit of detector V603A.

b. Resistor R613 is the grid-leak resistor. The +28 volts is applied to the screen grid (oscillator anode) through function switch S104, the contacts of BFO switch S102, P113-18, J613-18, and resistor R615. The suppressor grid (pin 2) is at ground potential. Capacitor C617 is the screen-grid bypass capacitor. The bfo output signal is developed across inductor L606. When the BFO switch is at OFF, +28 volts is disconnected from the plate and screen of the oscillator.

c. The frequency of the bfo signal can be varied over a range of 451 to 459 kc with BFO PITCH control C101. The frequency of the bfo is varied linearly over its entire range. When the BFO PITCH control is set to 0, the output of the bfo is exactly 455 kc. An adjustable core within L605 is used to obtain the proper frequency range during alignment and adjustment.

20. Delayed Agc Circuits
(fig. 14 and 15)

The agc circuit develops a negative dc potential which is proportional to the strength of the incoming signal. This negative dc potential is used as bias on first and second rf amplifiers, V201 and V202, and first and second if. amplifiers V501 and V502. This agc bias maintains

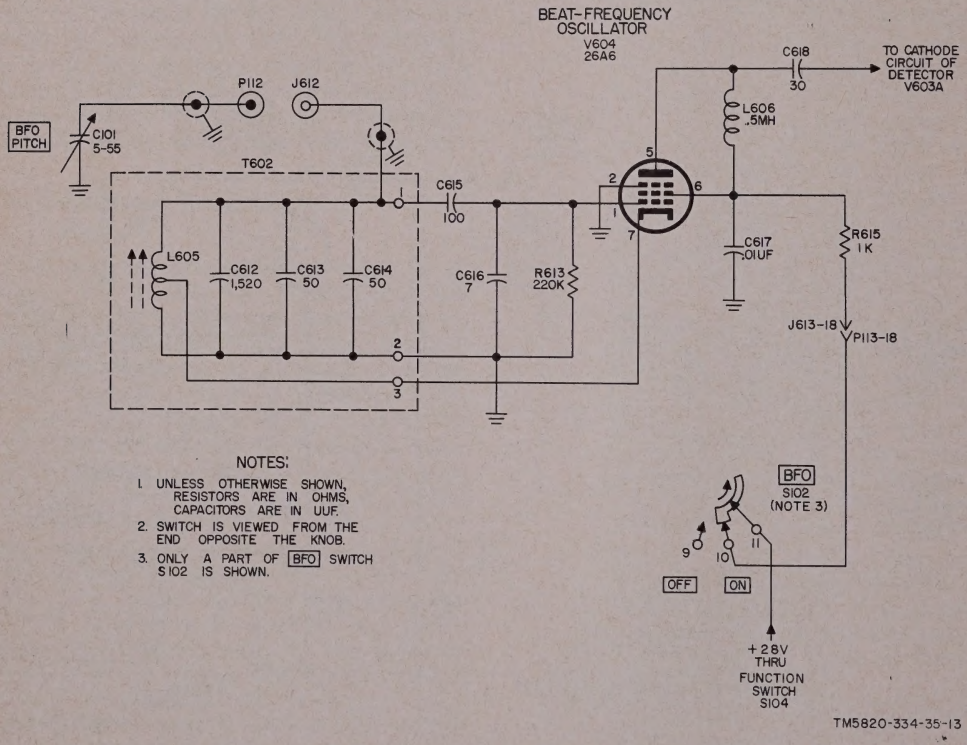


Figure 13. Beat-frequency oscillator, simplified schematic diagram.

constant receiver output for different signal levels at the antenna. In this discussion, the agc biased tubes are called the *controlled tubes*. The delayed agc circuits prevent the application of agc bias to the *controlled tubes* for weak incoming signals to provide maximum receiver gain for these signals. The agc circuit uses a type 26A6 miniature pentode (V609) and sections of two type 12AU7 miniature dual-triode tubes (V6-1B and V602A). The agc if. amplifier is V609; tubes V601B and V602A are connected as diode rectifiers. The rectifiers function only when AGC switch S101 is set to ON or CAL and the input signal voltage is greater than the agc delay voltage. The receiver gain can be controlled manually by the RF GAIN SQUELCH THRESH control whether AGC switch S101 is at ON or OFF.

a. Agc If. Amplifier V609 (fig. 14). Agc if. amplifier V609 operation is similar to that of if. amplifiers V501 through V506. The V609 output signal is developed across the tuned-plate circuit consisting of inductor L607 and capacitors C633 and C634. Trimmer capacitor C634 is for circuit alignment. Plate and screen-grid voltage is applied to V609 from switch S104 through P113-19 and J613-19 and through decoupling resistors R624 and R639. Capacitor C714 is an rf filter capacitor for the +28-volt line, and capacitor C635 is screen-grid and plate return bypass capacitor. The agc if. amplifier is grid-leak biased by the network consisting of capacitor C631 and resistor R637. The output of V609 is fed to four circuits: first rf agc rectifier V601B through capacitor C630; rf and if. agc rectifier V602A through capacitor C632; if. cathode follower C601A through capacitor C603; and squelch rectifier V602B through capacitor C619.

b. Rf and If. Agc Rectifier V602A (fig. 15). Rf and if. agc rectifier V602A is connected as a diode rectifier. The stage produces a negative dc potential, which is applied to the control grids of the second rf amplifier and the first and second if. amplifiers to control their gain. The receiver output level is held nearly constant, regardless of incoming signal strength variations.

(1) The 455-kc signal from if. amplifier V609 is coupled through capacitor C632 to the anode (plate and grid joined) of V602A. Tube V602A conducts only when the amplitude of the positive half-cycles of the input signal is greater than the positive dc (delay) potential on the cathode. When the input signal amplitude is less than the potential on the cathode, there is no conduction. The amplitude of the signal applied to V602A must exceed a delay voltage of between 5 and 6 volts for V602A to conduct. A large positive potential (with respect to ground) is applied to the cathode when the AGC switch is at OFF and V602A is cut off even for comparatively large signal voltages. The cathode of V602A is bypassed by capacitor C638. Pulsating negative voltage is developed across resistor R606 during reception of signals which exceed the delay voltage at V602A. This pulsating voltage is filtered by resistor R607 and capacitor C103 and C104 (dependent on position of BFO switch S102). The agc voltage is also filtered by resistor R502 and capacitor C502 and applied to the grid circuit of first if. amplifier V501. The agc voltage is also applied to the grid circuit of second if. amplifier V502 through filter network R508 and C508, and to the grid circuit of second rf amplifier V202 through J613-13, P113-13, P106-6, J206-6, and filter network R206 and C245.

(2) Capacitor C103 or C104 is connected into the circuit by a section of BFO switch S102 to control the time constant of the agc circuit. When BFO switch S102 is at OFF, capacitor C104 is connected into the circuit to provide the time constant required for voice reception. When S102 is at ON, C104 is disconnected, and C103 is connected to provide a longer time constant for cw reception. The longer time

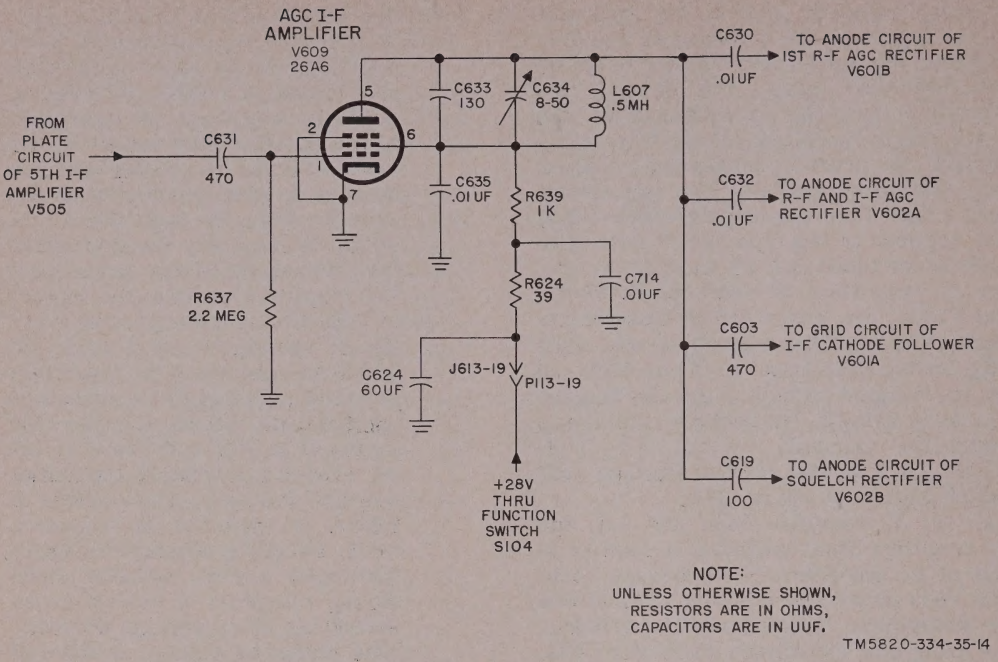


Figure 14. Agc if. amplifier V609, simplified schematic diagram.

constant prevents noticeable variations in gain due to keying. Jack J614 is a test point.

(3) An agc voltage is developed when a signal of approximately 3 to 5 microvolts is applied to the antenna and the RF GAIN SQUELCH THRESH control is maximum clockwise. This rf signal level is the minimum signal (rf threshold) required to cause agc action. It develops a voltage of approximately 3.2 volts dc across the detector (V603A) load resistor R605 (fig. 12). When the RF GAIN SQUELCH THRESH control is at a lower gain setting, a larger rf signal is required at the antenna to produce agc action.

(4) Agc delay bias is obtained from +28-volt voltage divider R610 and R609; the voltage across R609 is applied to the cathode of V602A. When the AGC switch is set to OFF, resistor R609 is off ground and the +28 volts at the junction of resistors R624 and R610 appears at the V602A cathode. This high bias voltage maintains V602A at cutoff for all incoming signals and no agc voltage is developed. When the AGC switch is at ON or CAL, a positive potential of between 5 and 6 volts (delay bias) is applied to the cathode of V602A.

c. First Rf Agc Rectifier V601B (fig. 15). First rf agc rectifier V601B operation is similar to that of rf and if. agc rectifier V602A except that the agc voltage from V601B is applied to the grid circuit of first rf amplifier V201 only. An independent agc system is provided for the first rf amplifier to prevent receiver blocking. Large off-tune rf voltages applied to the first rf amplifier might cause grid current flow and affect the biasing of

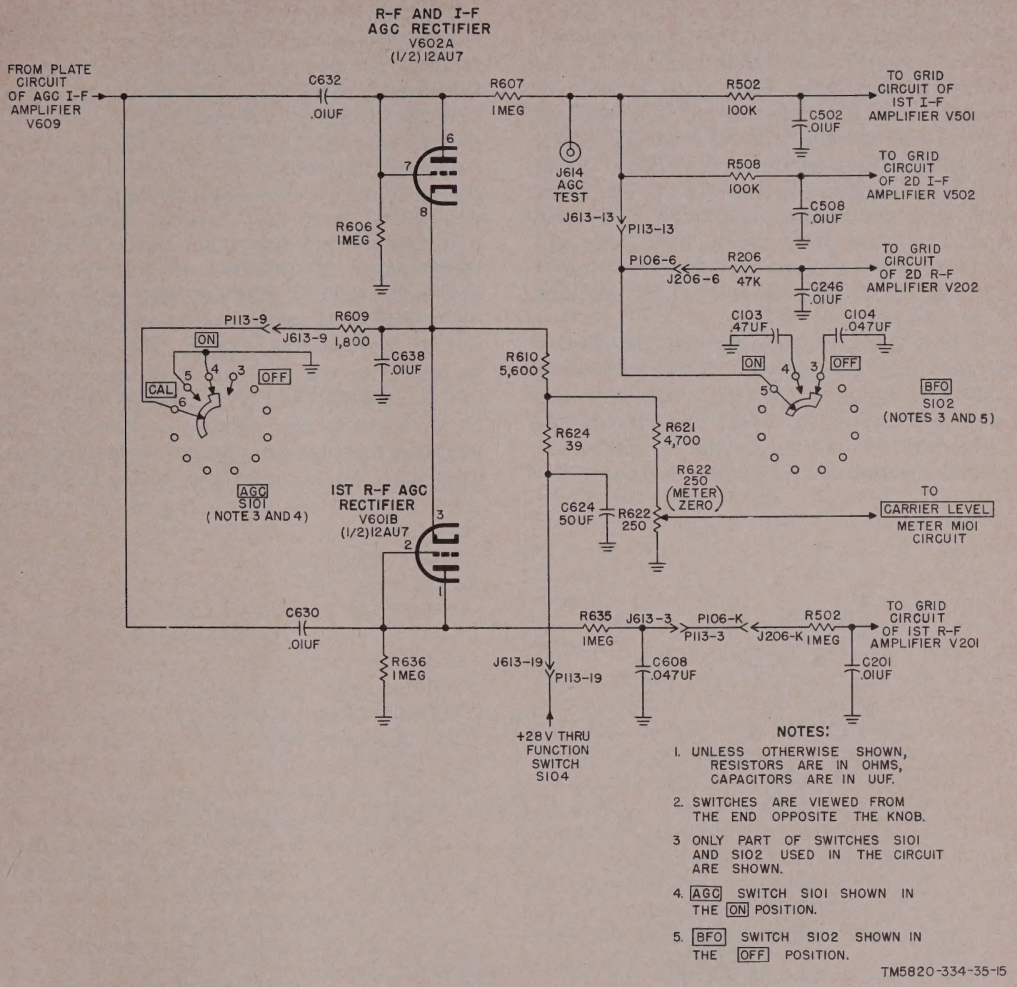


Figure 15. Agc rectifier circuits, simplified schematic diagram.

succeeding rf and if. amplifiers through a common agc system. The 455-kc output of V609 is coupled through capacitor C630 to the plate of diode-connected V601B. The plate and the grid of V601B are joined and returned to ground through resistor R636. The rectified pulsating negative dc voltage developed across R636 is filtered by resistor R635 and capacitor C608. The agc voltage is applied through J613-3, P113-3, P106-K, J206-K, and filter network R502 and C201, to the grid circuit of first rf amplifier V201. A +28-volt divider, R621 and R622, provides a meter zero voltage for CARRIER LEVEL meter M101.

21. CARRIER LEVEL Meter Circuit (fig. 16)

CARRIER LEVEL meter M101 indicates the relative signal strength in decibels (db) above the agc threshold (delay) voltage. It

is an aid in tuning, calibration, and alignment procedures. The CARRIER LEVEL meter circuit is a part of the second if. amplifier circuit (para 14).

a. Cathode bias for second if. amplifier V502 is developed across resistor R509. The +28 volts is applied to the plate of V502 through function switch S104, P113-19, J613-19, decoupling resistors R624 and R512, and the primary of T502. The +28 volts is also applied from the junction of R624 and R512 to voltage-divider network R621 and R622.

b. CARRIER LEVEL meter M101 is connected from the junction of the cathode of V502 and resistor R509 to the arm of meter zero potentiometer R622. The circuit arrangement is a bridge; the dc plate-to-cathode resistance of V502, resistor R621, and part of R622 are the upper arms, and cathode resistor R509 and part of potentiometer R622 are the lower arms. The negative terminal of the meter is connected to the top of R509 through P113-7, J613-7, and L506 (L506 prevents rf voltage from entering the meter circuit). The positive meter terminal connects through P113-10 and J613-10 to the arm of meter zero potentiometer R622. The meter zero potentiometer is adjusted so that the voltage between the arm of R622 and ground equals the voltage across R509 with no signal at the receiver input. The bridge is balanced in the absence of an agc voltage and the CARRIER LEVEL meter indicates zero. When an agc voltage is developed, a negative voltage is applied to the control grid of V502 through decoupling resistor

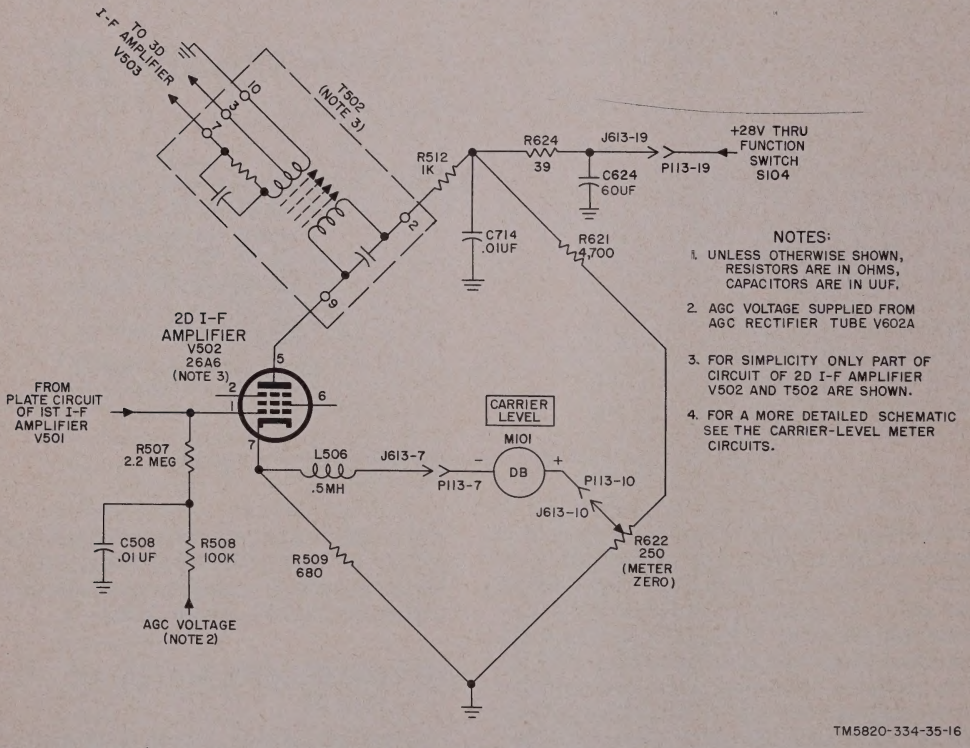


Figure 16. CARRIER LEVEL meter circuit, simplified schematic diagram.

R508, and through grid resistor R507. The amplitude of the agc voltage is dependent on the signal level. The greater the signal level, the larger the agc voltage developed. This additional bias voltage reduces plate current in V502 and the dc plate-to-cathode resistance of V502 is increased. The lower plate current decreases the voltage across R509, and a voltage is produced across the CARRIER LEVEL meter terminals. The meter indication represents the relative level of a received signal. The CARRIER LEVEL meter gives a true indication only when the AGC switch is at ON or CAL.

22. If. Cathode Follower V601A
(fig. 17)

If. cathode follower V601A uses one triode of a miniature dual-triode tube type 12AU7. It couples the 455-kc if. signal from the high impedance plate circuit of agc if. amplifier V609 to a low impedance load. This stage is necessary for operating an R-392/URR with a frequency-shift radio-teletypewriter converter.

a. The cathode is connected through resistors R603 and R604 to ground. Resistor R604 is the cathode load resistor and resistor R603 develops the necessary cathode bias. The +28 volts is applied to the plate through function switch S104, decoupling resistor R624 (bypassed by C714), and through inductor L604. Inductor L604 provides a high impedance to if. signals, and capacitor C605 places the plate at ground potential for if. signals.

b. The signal developed across cathode load resistor R604 is coupled through C604, J611, and P111, to IF OUT receptacle J105.

23. First Af Amplifier V606
(fig. 18)

The first af amplifier is a resistance-coupled amplifier that uses a type 6AJ5 miniature pentode tube to amplify the audio signals from the noise limiter. The amplified audio signals are fed to phase inverter V607.

a. The audio signal from noise limiter V603B is coupled by capacitor C610 through J613-8 and P113-8 to AF GAIN potentiometer R103. A portion of the signal voltage developed across R103 (depending on the position of the potentiometer arm) is coupled through P113-16, J613-16, capacitor C621, and resistor R642 to the control grid of V606. Resistor R623 is the grid resistor and is parallel-connected with C637 to ground. The signal is amplified by V606 and appears across plate-load resistor R626. The output signal is coupled to the grid circuit of phase inverter V607 through capacitor C623.

b. A negative feedback circuit is used in the first af amplifier to reduce distortion in the amplifier. The feedback is fed from the secondary winding of output transformer T603, through resistor R629, J613-16, and P113-6 to AF GAIN control R103; the feedback voltage is developed across R103. Resistor R642 and capacitor C637 form an rf filter network which removes rf from the V606 grid circuit; rf might be induced in the audio coupling lines by a nearby transmitter.

c. Contact bias is developed across R623. Capacitor C621 prevents the bias from being shunted through the lower resistance of resistor R642 in series with the arm and lower part of potentiometer R103. The cathode and suppressor grid are connected to ground. The +28 volts is applied to the screen grid (pin 6) through function switch S104, P113-19, J613-19, and voltage-dropping resistor R625, which is bypassed by capacitor C622. The plate (pin 5) circuit is completed through load resistor R626. Capacitor C624 filters the plate and screen returns.

24. Phase Inverter V607
(fig. 19)

Phase inverter V607 uses a type 6AJ5, miniature pentode tube, connected as a triode. Two signal voltages of equal amplitude, but 180° out of phase, are developed for application to the control grids of second af amplifier V607.

a. The audio signal from first af amplifier V606 is coupled by capacitor C623 to the grid of the phase inverter. The signal at the plate is developed across plate-load resistor R630 and is coupled by capacitor

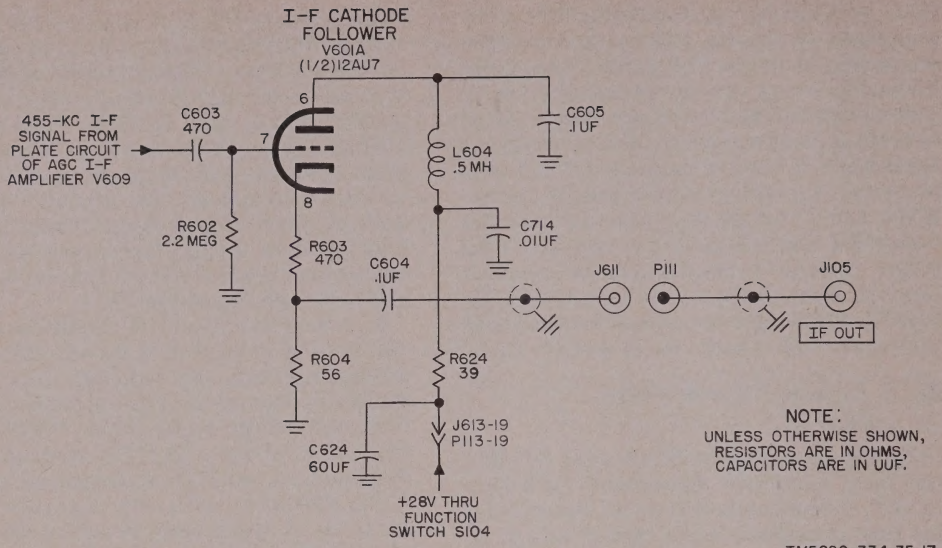


Figure 17. If. cathode follower V601A, simplified schematic diagram.

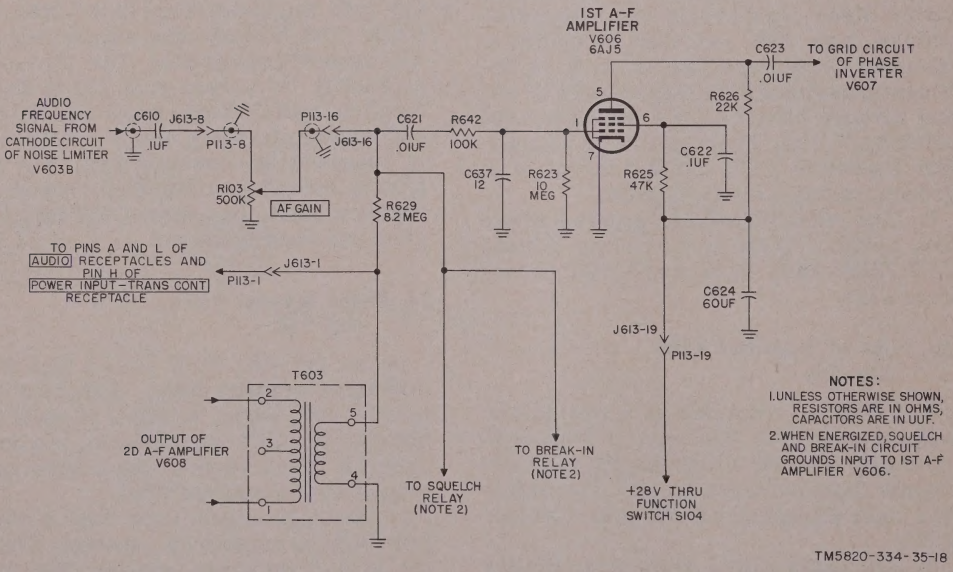


Figure 18. First af amplifier V606, simplified schematic diagram.

C626 to the control grid (pin 1) of second af amplifier V608A. An audio signal is also developed across cathode load resistor R628. This signal is equal in amplitude to the plate signal, but 180° out of phase. The cathodes signal is coupled by capacitor C627 to a control grid (pin 3) of second af amplifier V608B.

b. Contact bias is developed across resistor R627. The +28 volts is applied through function switch S104, P113-19, J613-19, and plate-load resistor R630 to the screen grid (pin 6) and plate (pin 5). Resistor R627 is connected directly from the cathode to the grid to accommodate negative signals of higher amplitude on the grid without the effects of cutoff limiting. The amplification of the tube is slightly less than one.

25. Second Af Amplifier V608 (fig. 19)

Second af amplifier V608 uses a type 26A7GT dual-pentode tube, connected as a push-pull amplifier. The af power output is applied to a 600-ohm headset or a loudspeaker.

a. The audio signal from phase inverter V607 is coupled to the control grids of V608 through capacitors C626 and C627. The audio voltage developed across R631 is of equal amplitude but 180° out of phase with the audio voltage developed across R632. The output from V608 is transformer coupled to a headset or loudspeaker by transformer T603. The primary of T603 is shunted by capacitor C628, which reduces the frequency response of the stage at the higher audiofrequencies. The audio output from the secondary winding is applied through J613-1 and P113-1 to pins A and L of AUDIO receptacles J101 and J102, and to pin H of POWER INPUT-TRANS CONT receptacle J103. Part of the audio signal is used as negative feedback through resistor R629 to the grid circuit of first af amplifier V606.

b. Grid bias is developed across resistors R631 and R632. The +28 volts is

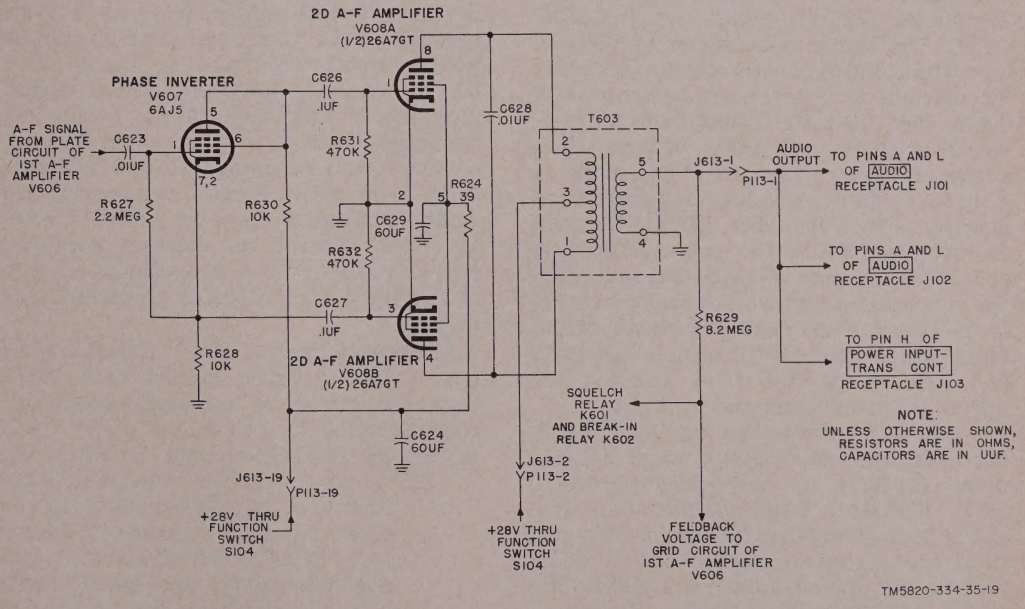


Figure 19. Phase inverter V607 and second audiofrequency amplifier V608, simplified schematic diagram.

applied to the screen grids through function switch S104, P113-19, J613-19, and resistor R624. The +28 volts is fed to the center tap (terminal 3) of the primary winding of T603 for application to the plates through function switch S104, P113-2, and J613-2.

26. Audio Module
(fig. 20)

Note. An audio module is used in place of V608 in certain receivers. The theory in this paragraph applies to receivers using an audio module.

The audio module is a transistorized plug-in unit designed to directly replace second af amplifier tube V608. The maximum audio output of the audio module is 1 watt with less than 7.5 percent distortion when operated with a 28-volt dc supply voltage.

a. When an audio module is used in place of V608, V607 acts as a cathode follower. The output signal taken across cathode resistor R628 is coupled by capacitor C627 to the base of transistor Q601 of the audio module.

b. Emitter follower Q601 matches the impedance between V607 and amplifier Q602. The audio input signal is coupled from the cathode of cathode follower V607, through pin 3 of the socket to the base of Q601. The +28 volts is applied to the collector of Q601 from pin 5 of the module socket. Resistors R643 and R644 make up a divider which provides the proper base bias for Q601. Resistor R645 is the load resistor for Q601. The output of Q601 is applied to the base of Q602. The audio output of Q602 is transformer coupled by T604 to the bases of the push-pull power output stage which consists of transistors Q603 and Q604. Capacitor C638 reduces the higher frequency response of T604.

c. The +28 volts is applied from pin 6 of the audio module socket through the primary of T605 to the collectors of Q603 and Q604. Resistors R647 and R648 establish the proper base bias. Resistors R650 and R651 are in the emitter circuits to compensate for temperature variations. Resistor R649 provides a negative feedback current to Q602 for improved amplifier gain stability and frequency response. The output signal from the collectors of Q603 and Q604 is transformer coupled through transformer T605 and applied directly through pin connections 4 and 8 of the audio module base to the primary winding of transformer T603.

27. Squelch Circuit
(fig. 21)

The squelch circuit is operative when function switch S104 is in the SQ position. In the absence of a carrier, or when a weak incoming signal carrier is received, squelch relay K601 is energized, grounding the input of first af amplifier V606. When the carrier is sufficiently strong, the squelch relay becomes deenergized, and the ground is removed from the input to first af amplifier V606. The squelch circuit uses squelch rectifier V602B and squelch control V605.

a. Squelch Rectifier V602B. Squelch rectifier V602B rectifies the 455-kc if. signal from agc if. amplifier V609 and develops a negative bias which controls the operation of squelch control V605. Squelch rectifier V602B is connected as a diode rectifier. The plate and control grid of V602B are connected together and the cathode is connected to ground. The if. signal from agc if. amplifier V609 is coupled by capacitor C619 to the plate of diode-connected V602B. Resistor R616 and capacitor C620 form a filter which removes rf and audio components from the rectified voltage. The filtered dc voltage developed across resistor R619 is applied to the grid of squelch control V605 as a negative bias voltage.

b. Squelch Control V605. Squelch control V605 activates squelch relay K601 under no signal or low signal conditions (dependent on the setting of RF GAIN SQUELCH THRESH control R105 (fig. 9)).

(1) A more negative voltage than the threshold voltage across R619 reduces the plate current of V605 and relay K601 is deenergized. A less negative voltage than the threshold voltage increases the current of V605, and relay K601 is energized.

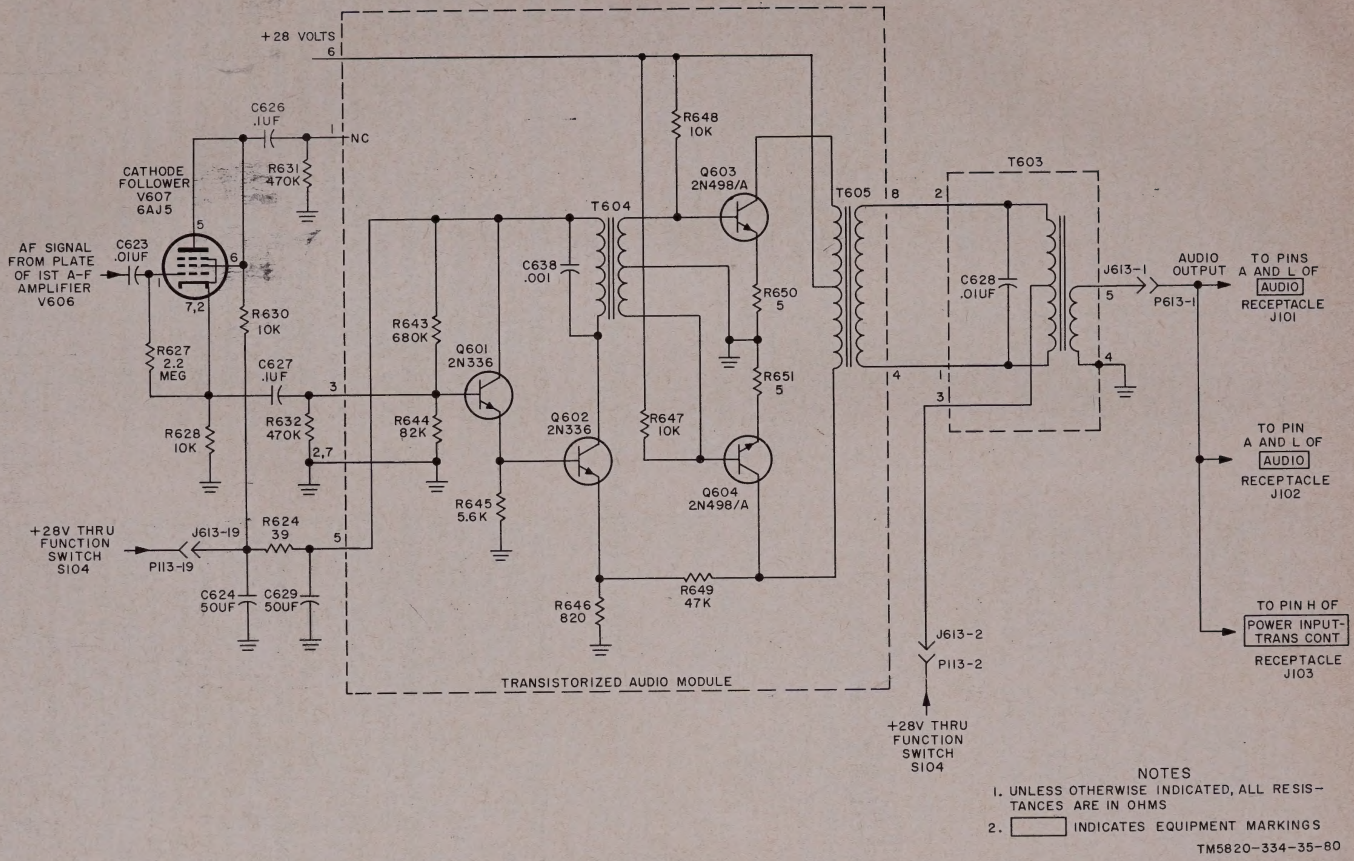


Figure 20. Audio module, schematic diagram.

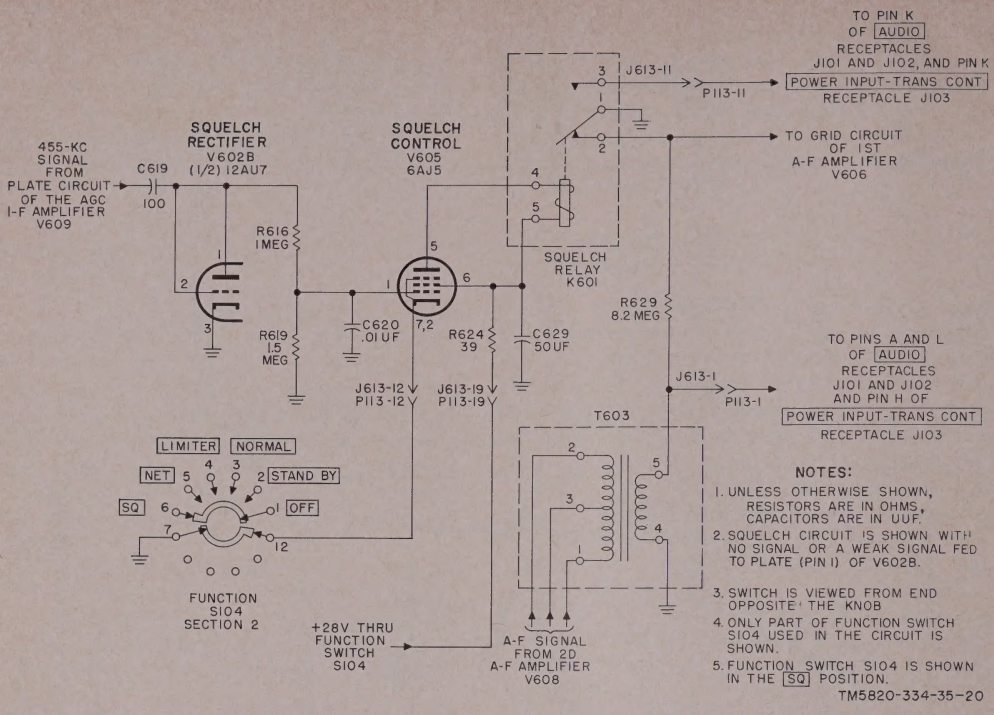


Figure 21. Squelch circuit, simplified schematic diagram.

The amplitude of the rectified signal applied to V605 is controlled by setting the RF GAIN SQUELCH THRESH control. The effect of turning the RF GAIN SQUELCH THRESH control counterclockwise (lower gain setting) is to require a larger signal at the antenna to exceed the necessary threshold voltage.

(2) The cathode of V605 is connected to ground through J613-12, P113-12, and the contacts of function switch S104, section 2, when the function switch is set to SQ. Grid bias is developed by the rectified if. signal across resistor R619. The +28 volts is applied through function switch S104, P113-19, J613-19, and decoupling resistor R624, to the screen grid, and through the winding of K601 to the plate.

(3) Capacitor C629 bypasses the screen grid and plate return. When V605 conducts, squelch relay K601 is energized, closing contacts 1 and 2 and grounding the input of first af amplifier V606. When K601 is deenergized, contacts 1 and 2 open and ground is removed from the input of first af amplifier V606.

(4) The carrier-relay (retransmission) circuit in the associated transmitter is controlled by K601. When an adequate signal is received, K601 is deenergized, contact 1 and contact 3 close, and the carrier-relay circuit of the transmitter is grounded through J613-11, P113-11, and pin K of POWER INPUT-TRANS CONT receptacle

J103 or pin K of AUDIO receptacles J101 and J102.

28. Calibration Oscillator Circuit (fig. 22, 23, and 24)

The function of the calibration oscillator circuit is to provide standard frequencies, in 100-kc steps, in the range of 0.5 to 32 mc. When the AGC switch is at CAL, the cathode circuits in the calibration oscillator are completed to ground through AGC switch S101. The calibration-oscillator circuit consists of 200-kc crystal oscillator V702, multivibrator V701, harmonic amplifier V703A, and distorter V703B.

29. Crystal Oscillator V702, 200-Kc (fig. 22)

The 200-kc crystal oscillator uses a type 26A6 miniature pentode tube, connected as an electron-coupled Pierce oscillator. The oscillator furnishes a 200-kc signal to synchronize multivibrator V701.

a. The screen grid acts as the anode of the Pierce oscillator circuit. Crystal Y701, connected between the control grid and the anode, takes the place of the conventional tuned circuit. Capacitor C708 blocks dc voltage from the crystal and couples rf from the oscillator anode to the crystal. Capacitor C709 is effectively in series with adjustable capacitor C706 to provide the proper amount of feedback voltage to the grid to sustain oscillations. Capacitor C706 also permits frequency adjustment of the 200-kc crystal oscillator. Electron coupling to the plate of V702 minimizes instability caused by variations in plate load. Capacitor C711 couples the output of V702 to the grid circuit of harmonic amplifier V703A; the input signal to V703A is developed across a parallel-tuned circuit, consisting of inductor L701 and the inductor distributed capacitance and input capacitance of V703A. The V702 output signal is also coupled by capacitor C704 to the grid circuit of multivibrator V701.

b. Tube V702 is grid-leak biased by the voltage across resistor R706. The suppressor grid and cathode are connected through J613-4, P113-4, and the contacts of AGC switch S101 to ground when the AGC switch is at CAL. The +28 volts for the screen grid is applied through function switch S104, P113-19, J613-19, decoupling resistor R624 (bypassed by capacitor C714), and through resistor R707. The plate circuit is completed through plate-load resistor R708 from the junction of resistors R707 and R624. The cathodes of the remaining tubes in the calibration-oscillator circuit (V703A, 703B, and V701) are connected to the cathode of V702. Capacitors C710 and C715 prevent rf currents from entering the front panel through the lead to AGC switch S101.

30. Multivibrator V701 (fig. 23)

The signal from 200-kc crystal oscillator V702 is used to synchronize multivibrator V701 at 100 kc. The nearly square wave output of multivibrator V701 is composed of a large number of harmonics.

a. The cathodes of V701 are returned to ground through J613-4, P113-4, and the contacts of AGC switch S101, when the AGC switch is at CAL. Grid bias is developed across resistors R701 and R702 for V701A, and across resistors R705 and R702 for V701B. The +28 volts is applied through function switch S104, P113-19, J613-19, decoupling resistor R624, and resistor R704, to the plate (pin 6) of V701B, and through resistor R703 to the plate (pin 1) of V701A. Capacitors C710 and C715 bypass rf voltages to ground (para 29).

b. The signal from 200-kc crystal oscillator V702 is coupled by capacitor C704 to multivibrator V701. Multivibrator V701 is a free-running relaxation-type oscillator, which uses a type 12AU7 miniature dual-triode tube. Oscillations are sustained by feedback from the plate of one tube section to the grid of the other tube section. The free-running frequency is determined by the time constants of the combination of resistors R701, R702, and R705, capacitors C701 and C702. The 200-kc signal from 200-kc crystal oscillator V702 is developed across resistor R702. This voltage synchronizes the multivibrator precisely at 100 kc. The V701 output signal is applied

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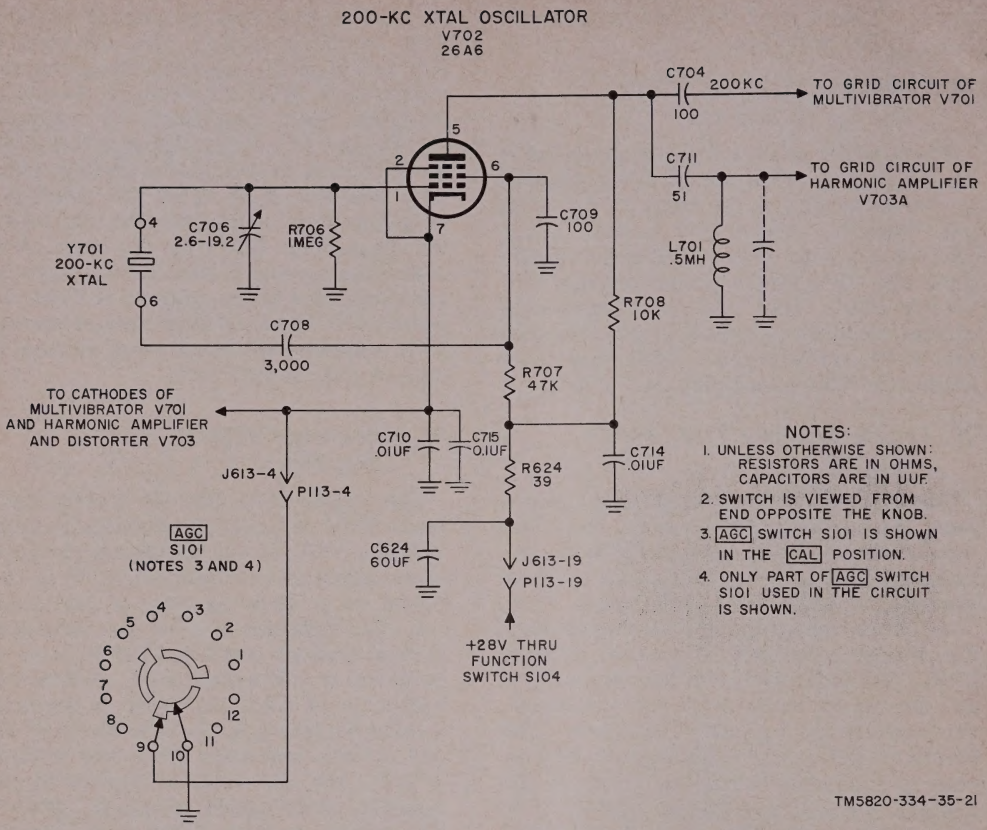


Figure 22. 200-kc crystal oscillator, simplified schematic diagram.

through capacitor C703 to the grid circuit of harmonic amplifier V703A.

31. Harmonic Amplifier V703A (fig. 24)

Harmonic amplifier V703A uses a triode section of a type 12AU7 miniature dual-triode tube. Signals from two sources are combined in the V703A grid circuit. The composite signal is amplified and the signal peaks are clipped to increase the harmonic output.

a. The cathode (pin 3) is returned to ground through J613-4, P113-4, and the contacts of AGC switch S101, when the AGC switch is set to CAL. Capacitors C710 and C715 bypass rf voltages to ground. The grid circuit is completed to ground through inductor L701. The +28 volts is applied through function switch S104, P113-19, J613-19, decoupling resistor R624, and plate-load resistor R709 to the plate (pin 1) of V703A.

b. The 100-kc square wave signal from multivibrator V701 is coupled through capacitor C703, and the 200-kc sine wave signal from 200-kc crystal oscillator V702 is coupled through capacitor C711 to the control grid of V703A. These signals combine to form a complex wave which is rich in harmonics. Inductor L701, inductor distributed capacitance, and the input capacitance to V703A tune the grid circuit broadly to approximately 1,000 kc. The amplified signals developed across R709 are coupled through capacitor C712 to the control grid of distorter V703B.

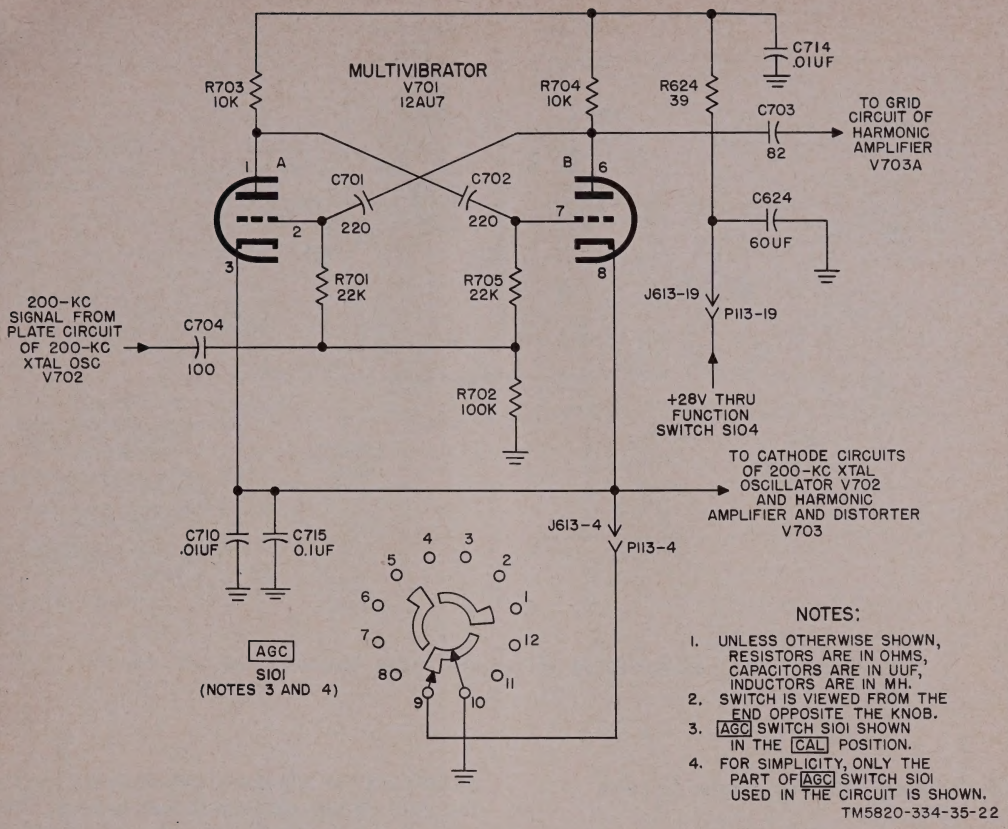


Figure 23. Multivibrator V701, simplified schematic diagram.

32. Distorter V703B
(fig. 24)

Distorter V703B uses a triode section of a type 12AU7 miniature dual-triode tube. Distorter V703B distorts the output from harmonic amplifier V703A. The operation of distorter V703B is similar to the operation of harmonic amplifier V703A.

a. The cathode of distorter V703B is connected to the V703A cathode. The grid is connected to ground through resistor R711. The +28 volts is applied to the plate through R624 and plate-load resistor R710.

b. The signal from harmonic amplifier V703A is coupled by capacitor C712 to the grid of V703B. Distortion of the input signal results from grid limiting and plate current cutoff. The output signal of V703B is developed across plate load resistor R710 and coupled to inductor L702 through capacitor C713. Inductor L702, shunted by wiring, distributed, and tube capacitances, increases harmonics in the range of 27 to 28 mc. The signal is then coupled through the floor-plate contact to the grid circuit of first rf amplifier V201. This signal provides for calibration at all 100-kc points throughout the range of the receiver.

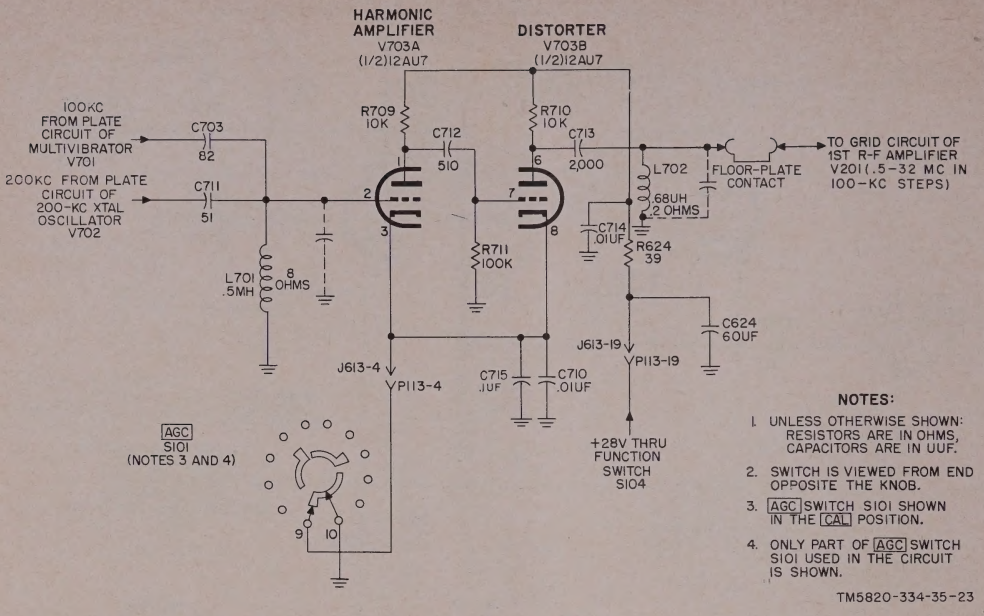


Figure 24. Harmonic amplifier V703A and distorter V703B, simplified schematic diagram.

33. Filament and Oven-Heater Circuits (fig. 25)

The external power source (28 volts dc) is applied between pins D and E (ground) of POWER INPUT-TRANS CONT receptacle J103. Nominal filament voltages of 6.3, 12.6, and 25.2 volts are required for the tubes in the receiver. Dial lamps I201, I202, and the filaments which require nominal 25.2 volts are parallel-connected with the source voltage. The filaments which require 6.3 or 12.6 volts are connected in series circuits. Capacitor-inductor filter combinations are used to prevent interstage coupling of high-frequency signals through the filament circuits. These filters are C302, L232-C301, L233-C300, C458-L407-C459, C460-L408-C461, C531, C607, and C807-L804-C805. Resistor R641 reduces the voltage across the filament of V605 to 6.3 volts. Resistor R633 is a filament shunt for V601. Crystal oven HR701 stabilizes the 200-kc crystal oscillator in the calibration-oscillator subchassis. The oven temperature is controlled by a thermostatic switch. Capacitor C705 is connected across the thermostatic switch contacts to minimize interference caused by switch arcing. LINE 5 AMP fuse F102 protects the external power source from filament and oven-heater circuit shorts. When function switch S104 is set to OFF, filament voltage is disconnected. Filament voltage is connected in all other function switch positions. The dial lamps are fully lighted when DIAL DIM switch S103 is set to ON and are disconnected in the OFF position. At the intermediate switch position, resistor R101 is series-connected with the dial lamps and they light at reduced brilliance. Antenna relay K101 and break-in relay K602 are discussed in paragraph 35.

Note. A transistorized audio module is used in place of V608 in certain receivers.

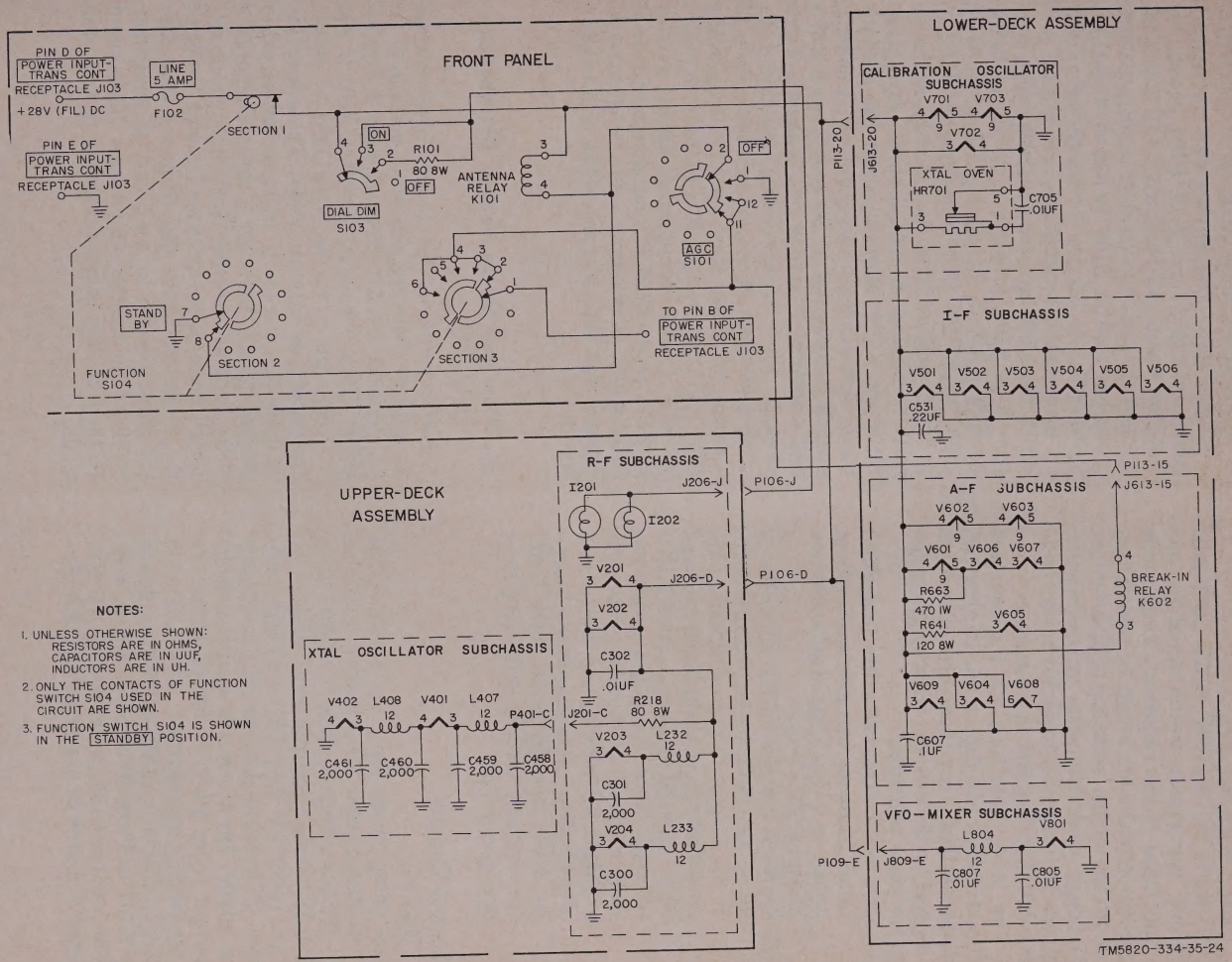


Figure 25. Filament and oven-heater circuits, simplified schematic diagram.

34. Function Switch S104
(fig. 26)

a. Function switch S104 performs switching operations which affect the entire operation of the receiver. Each mode of operation and each stage is affected by the positions of the sections of this switch. A thorough understanding of the switch functions is essential to perform successful troubleshooting and maintenance.

b. The six positions of the function switch are shown in figure 26. To simplify the presentation, only those circuits which are closed by the switch contacts are identified for each position.

(1) *Section 1.* The +28 volts is applied to all filament circuits and antenna break-in relay K101 in all positions except OFF.

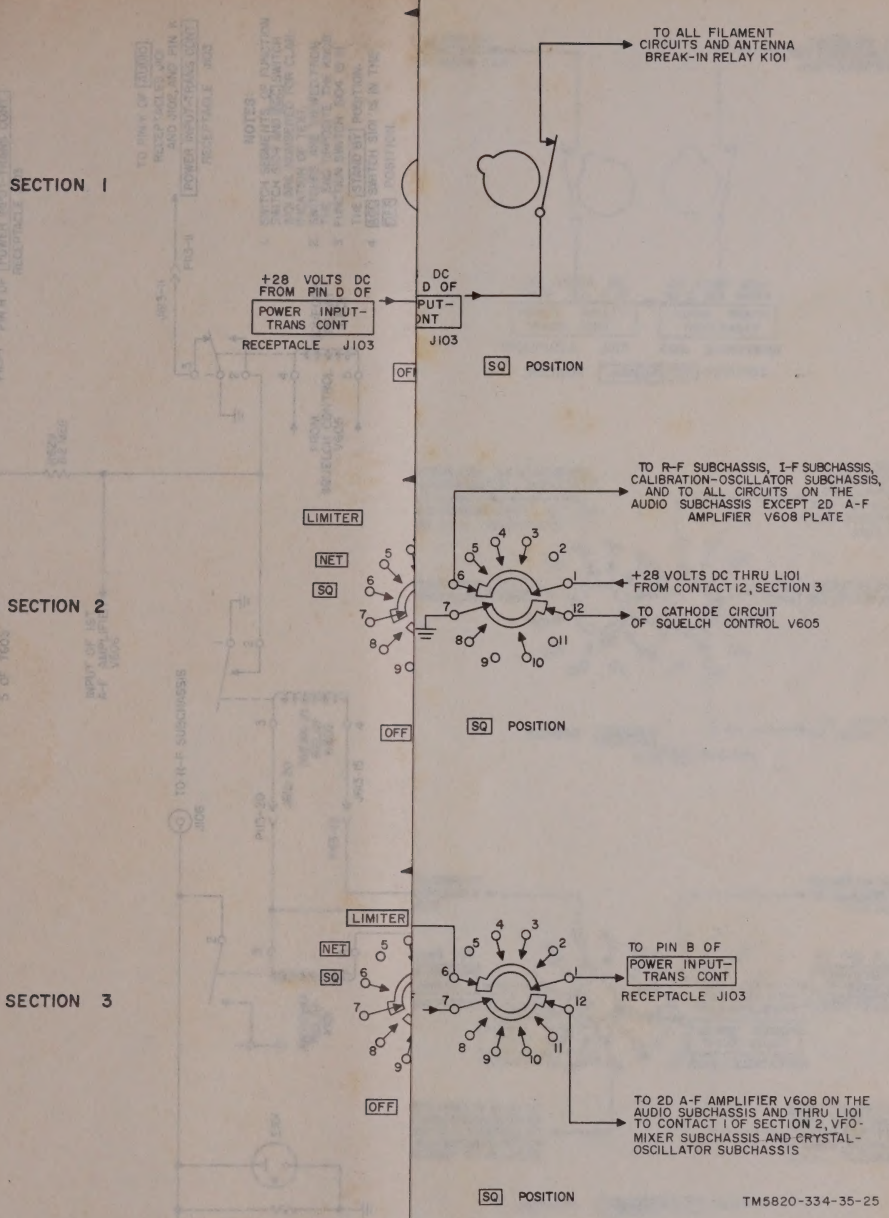
(2) *Sections 2 and 3.* The +28 volts is made available to the plate circuits of all stages of the receiver in all positions of sections 2 and 3 except OFF and STAND BY. At STAND BY, +28 volts is applied only to the plate circuits of the vfo-mixer, the crystal oscillators, and the second af amplifier; antenna break-in relay K101 and break-in relay K602 are connected for break-in operation (para 35).

35. Control Circuits
(fig. 27)

When using Radio Receiver R-392/URR with an associated transmitter, such as Radio Transmitter T-195/GRC-19, it is necessary, under certain conditions, to disable receiver circuits during transmission to prevent damage and to silence the receiver. The 28-volt dc source voltage is applied from pin D of POWER INPUT-TRANS CONT receptacle J103 through section 1 of function switch S104 to antenna relay K101 and break-in relay K602. When function switch S104 is set to STAND BY, contacts 7 and 8 of section 2 ground terminal 4 of antenna relay K101 and terminal 4 of break-in relay K602 (through AGC switch S101). The relays are energized, and contacts 1 and 2 of K101 ground the antenna input and contacts 1 and 2 of K602 ground the input to first af amplifier V606. Function switch S104 is set to NORMAL, LIMITER, or SQ for break-in operation. In these switch positions, terminals 4 of K101 and K602 are connected through section 3 of S104 (contact 1 is connected to contact 2, 3, 4, or 6) to pin B of POWER INPUT-TRANS CONT receptacle J103. A ground, applied from the associated transmitter during transmission, energizes K602 and K101, short circuits the antenna input, and silences the receiver. Function switch S104 is set to SQ (contacts 6 and 1 and contacts 7 and 12 of section 3 are closed) for carrier-relay (retransmission) operation. The carrier-relay line is terminated at pin K of AUDIO receptacles J101 and J102 and pin K of POWER INPUT-TRANS CONT receptacle J103. When squelch relay K601 is energized (receiver squelched), contacts 1 and 3 of K601 are opened and the carrier-relay line is disabled.

36. Plate and Screen Voltage Distribution
(fig. 28)

The external power source of 28 volts dc is applied between pin A (+) and pin E (-) of POWER INPUT-TRANS CONT receptacle J103. When BFO switch S102 is set to ON, +28 volts is applied to beat-frequency oscillator V604. The operation of function switch S104 is explained in paragraph 34. Inductor L101 and capacitor C624 form a +28-volt line filter which decouples the plate circuits (except V608) of the receiver from the filament circuits; the plate circuit of second af amplifier V608 is connected through J613-2 and P113-2 to the input terminal of inductor L101.


SECTION 1
TO ALL FILAMENT CIRCUITS AND ANTENNA BREAK-IN RELAY K101
+28 VOLTS DC FROM PIN D OF
POWER INPUT-TRANS CONT
RECEPTACLE J103
J103
SQ POSITION
SECTION 2
TO R-F SUBCHASSIS, 1-F SUBCHASSIS, CALIBRATION-OSCILLATOR SUBCHASSIS, AND TO ALL CIRCUITS ON THE AUDIO SUBCHASSIS EXCEPT 2D A-F AMPLIFIER V608 PLATE
LIMITER
NET
SQ
+28 VOLTS DC THRU L101 FROM CONTACT 12, SECTION 3
TO CATHODE CIRCUIT OF SQUELCH CONTROL V605
OFF
SQ POSITION
SECTION 3
LIMITER
NET
SQ
TO PIN B OF
POWER INPUT-TRANS CONT
RECEPTACLE J103
TO 2D A-F AMPLIFIER V608 ON THE AUDIO SUBCHASSIS AND THRU L101 TO CONTACT 1 OF SECTION 2, VFO-MIXER SUBCHASSIS AND CRYSTAL-OSCILLATOR SUBCHASSIS
OFF
SQ POSITION

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34. Function Switch S104
(fig. 26)

a. Function switch S104 performs switching operations which affect the entire operation of the receiver. Each mode of operation and each stage is affected by the positions of the sections of this switch. A thorough understanding of the switch functions is essential to perform successful troubleshooting and maintenance.

b. The six positions of the function switch are shown in figure 26. To simplify the presentation, only those circuits which are closed by the switch contacts are identified for each position.

(1) *Section 1.* The +28 volts is applied to all filament circuits and antenna break-in relay K101 in all positions except OFF.

(2) *Sections 2 and 3.* The +28 volts is made available to the plate circuits of all stages of the receiver in all positions of sections 2 and 3 except OFF and STAND BY. At STAND BY, +28 volts is applied only to the plate circuits of the vfo-mixer, the crystal oscillators, and the second af amplifier; antenna break-in relay K101 and break-in relay K602 are connected for break-in operation (para 35).

35. Control Circuits
(fig. 27)

When using Radio Receiver R-392/URR with an associated transmitter, such as Radio Transmitter T-195/GRC-19, it is necessary, under certain conditions, to disable receiver circuits during transmission to prevent damage and to silence the receiver. The 28-volt dc source voltage is applied from pin D of POWER INPUT-TRANS CONT receptacle J103 through section 1 of function switch S104 to antenna relay K101 and break-in relay K602. When function switch S104 is set to STAND BY, contacts 7 and 8 of section 2 ground terminal 4 of antenna relay K101 and terminal 4 of break-in relay K602 (through AGC switch S101). The relays are energized, and contacts 1 and 2 of K101 ground the antenna input and contacts 1 and 2 of K602 ground the input to first af amplifier V606. Function switch S104 is set to NORMAL, LIMITER, or SQ for break-in operation. In these switch positions, terminals 4 of K101 and K602 are connected through section 3 of S104 (contact 1 is connected to contact 2, 3, 4, or 6) to pin B of POWER INPUT-TRANS CONT receptacle J103. A ground, applied from the associated transmitter during transmission, energizes K602 and K101, short circuits the antenna input, and silences the receiver. Function switch S104 is set to SQ (contacts 6 and 1 and contacts 7 and 12 of section 3 are closed) for carrier-relay (retransmission) operation. The carrier-relay line is terminated at pin K of AUDIO receptacles J101 and J102 and pin K of POWER INPUT-TRANS CONT receptacle J103. When squelch relay K601 is energized (receiver squelched), contacts 1 and 3 of K601 are opened and the carrier-relay line is disabled.

36. Plate and Screen Voltage Distribution
(fig. 28)

The external power source of 28 volts dc is applied between pin A (+) and pin E (-) of POWER INPUT-TRANS CONT receptacle J103. When BFO switch S102 is set to ON, +28 volts is applied to beat-frequency oscillator V604. The operation of function switch S104 is explained in paragraph 34. Inductor L101 and capacitor C624 form a +28-volt line filter which decouples the plate circuits (except V608) of the receiver from the filament circuits; the plate circuit of second af amplifier V608 is connected through J613-2 and P113-2 to the input terminal of inductor L101.

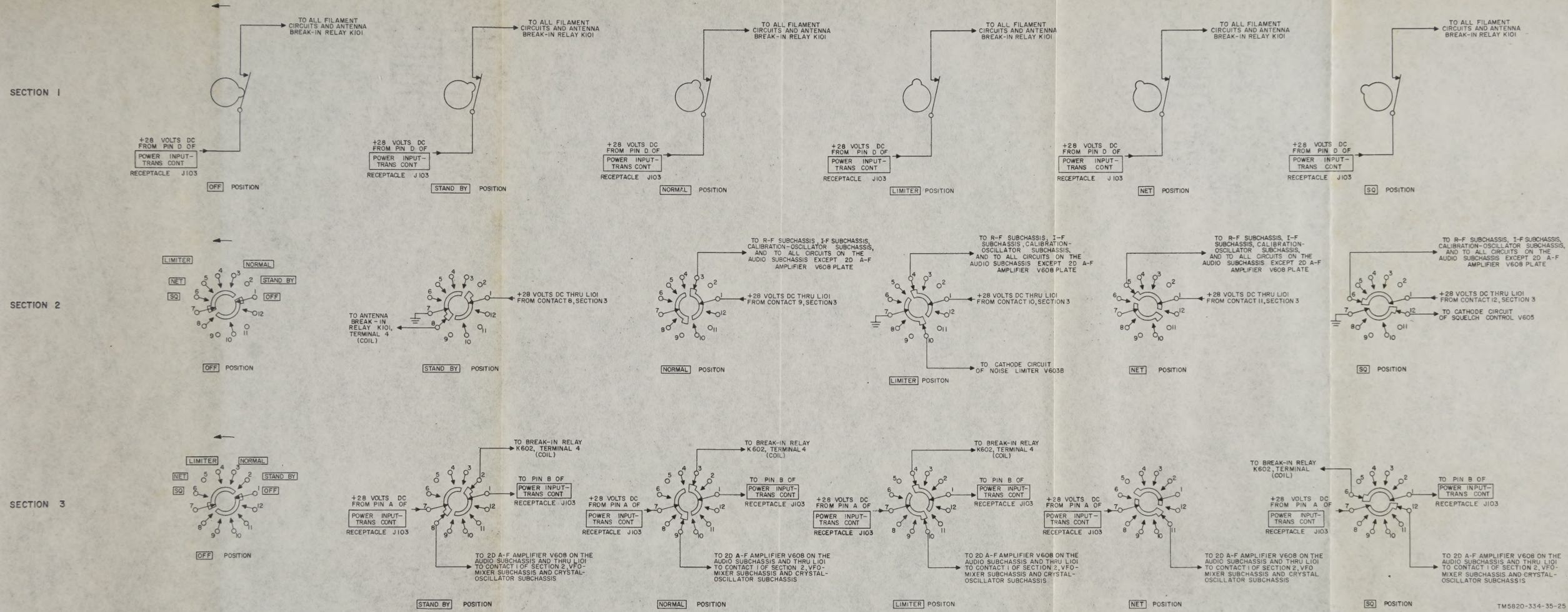
SECTION 1
TO ALL FILAMENT CIRCUITS AND ANTENNA BREAK-IN RELAY K101
+28 VOLTS DC FROM PIN D OF POWER INPUT-TRANS CONT RECEPTACLE J103
OFF POSITION
STAND BY POSITION
NORMAL POSITION
LIMITER POSITION
NET POSITION
SQ POSITION
SECTION 2
LIMITER
NORMAL
NET
STAND BY
SQ
OFF
TO ANTENNA BREAK-IN RELAY K101, TERMINAL 4 (COIL)
+28 VOLTS DC THRU L101 FROM CONTACT 8, SECTION 3
TO R-F SUBCHASSIS, I-F SUBCHASSIS, CALIBRATION-OSCILLATOR SUBCHASSIS, AND TO ALL CIRCUITS ON THE AUDIO SUBCHASSIS EXCEPT 2D A-F AMPLIFIER V608 PLATE
+28 VOLTS DC THRU L101 FROM CONTACT 9, SECTION 3
+28 VOLTS DC THRU L101 FROM CONTACT 10, SECTION 3
TO CATHODE CIRCUIT OF NOISE LIMITER V603B
+28 VOLTS DC THRU L101 FROM CONTACT 11, SECTION 3
+28 VOLTS DC THRU L101 FROM CONTACT 12, SECTION 3
TO CATHODE CIRCUIT OF SQUELCH CONTROL V605
SECTION 3
TO BREAK-IN RELAY K602, TERMINAL 4 (COIL)
TO PIN B OF POWER INPUT-TRANS CONT RECEPTACLE J103
+28 VOLTS DC FROM PIN A OF POWER INPUT-TRANS CONT RECEPTACLE J103
TO 2D A-F AMPLIFIER V608 ON THE AUDIO SUBCHASSIS AND THRU L101 TO CONTACT 1 OF SECTION 2, VFO-MIXER SUBCHASSIS AND CRYSTAL-OSCILLATOR SUBCHASSIS
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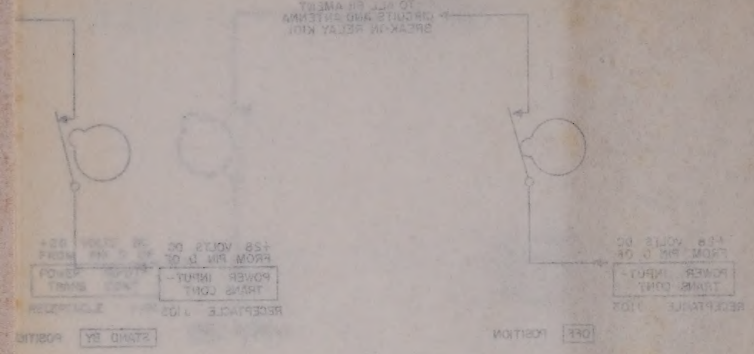
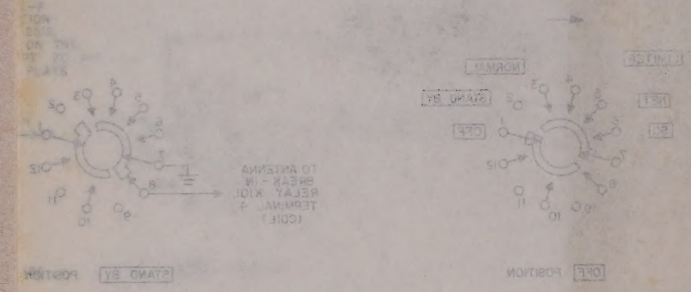
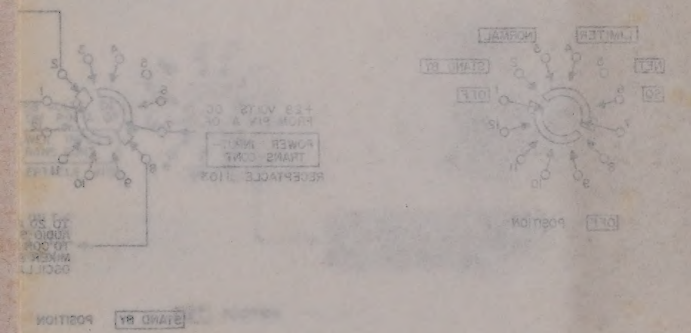
Figure 26. Function switch S104, schematic diagram.


POWER INPUT-TRANS. CONT.
OFF POSITION


NORMAL
OFF POSITION


NORMAL
OFF POSITION

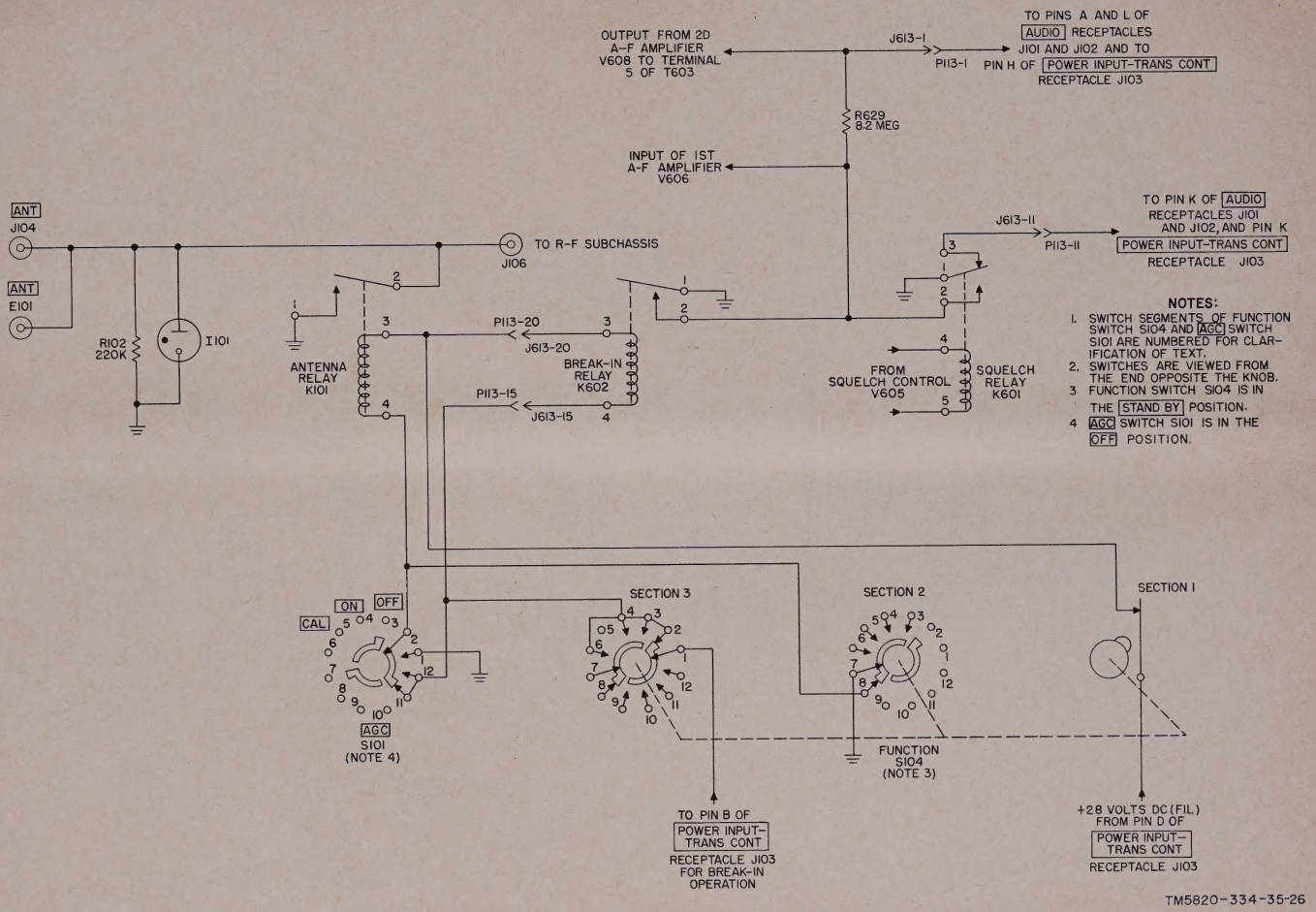

OUTPUT FROM 2D A-F AMPLIFIER V608 TO TERMINAL 5 OF T603
J613-1
P113-1
TO PINS A AND L OF AUDIO RECEPTACLES J101 AND J102 AND TO PIN H OF POWER INPUT-TRANS CONT RECEPTACLE J103
R629 8.2 MEG
INPUT OF 1ST A-F AMPLIFIER V606
ANT J104
ANT E101
TO R-F SUBCHASSIS J106
R102 220K
T101
ANTENNA RELAY K101
P113-20
J613-20
BREAK-IN RELAY K602
P113-15
J613-15
J613-11
P113-11
TO PIN K OF AUDIO RECEPTACLES J101 AND J102, AND PIN K POWER INPUT-TRANS CONT RECEPTACLE J103
FROM SQUELCH CONTROL V605
SQUELCH RELAY K601
NOTES:
1. SWITCH SEGMENTS OF FUNCTION SWITCH S104 AND AGC SWITCH S101 ARE NUMBERED FOR CLARIFICATION OF TEXT.
2. SWITCHES ARE VIEWED FROM THE END OPPOSITE THE KNOB.
3 FUNCTION SWITCH S104 IS IN THE STAND BY POSITION.
4 AGC SWITCH S101 IS IN THE OFF POSITION.
ON
OFF
CAL
AGC
S101 (NOTE 4)
SECTION 3
SECTION 2
SECTION 1
FUNCTION S104 (NOTE 3)
TO PIN B OF POWER INPUT-TRANS CONT RECEPTACLE J103 FOR BREAK-IN OPERATION
+28 VOLTS DC (FIL) FROM PIN D OF POWER INPUT-TRANS CONT RECEPTACLE J103
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Figure 27. Control circuits, functional diagram.

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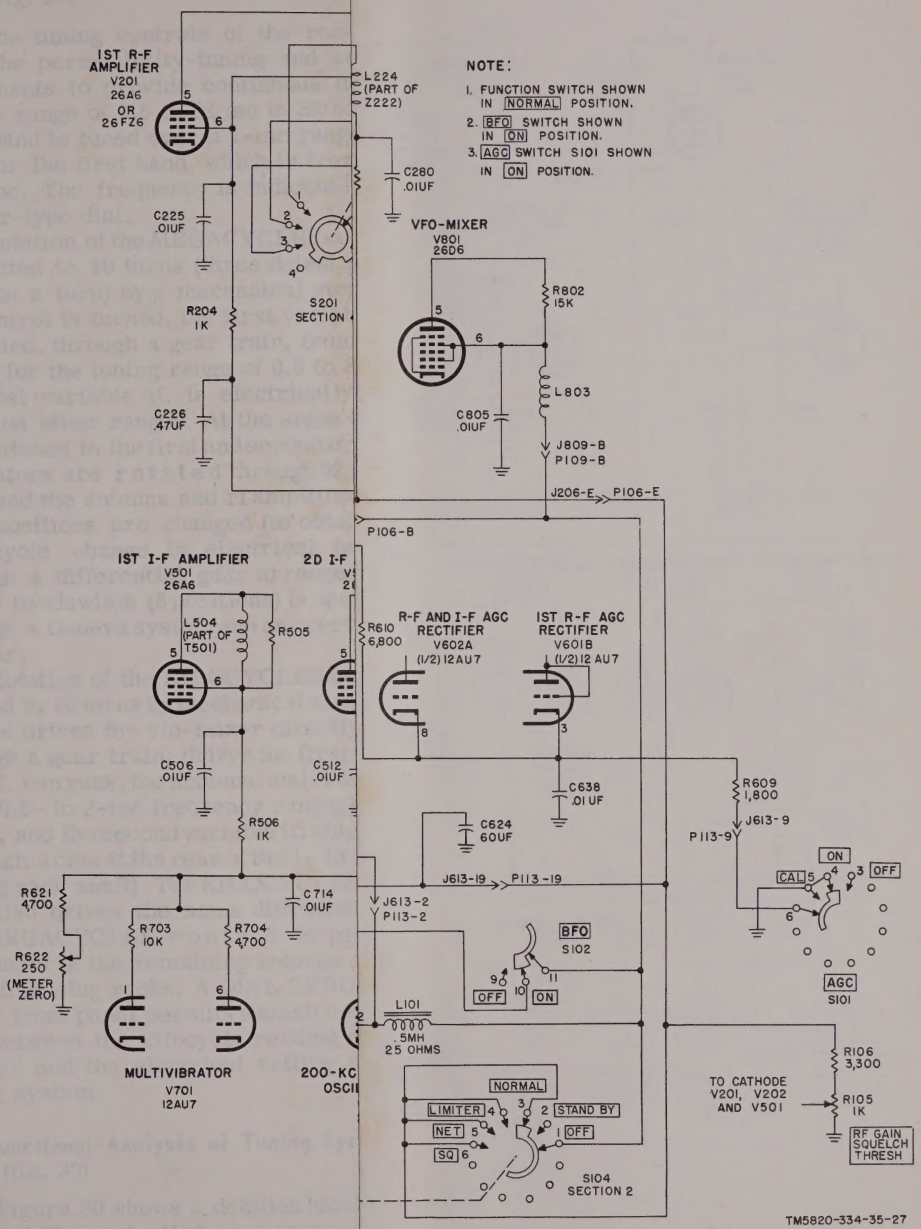

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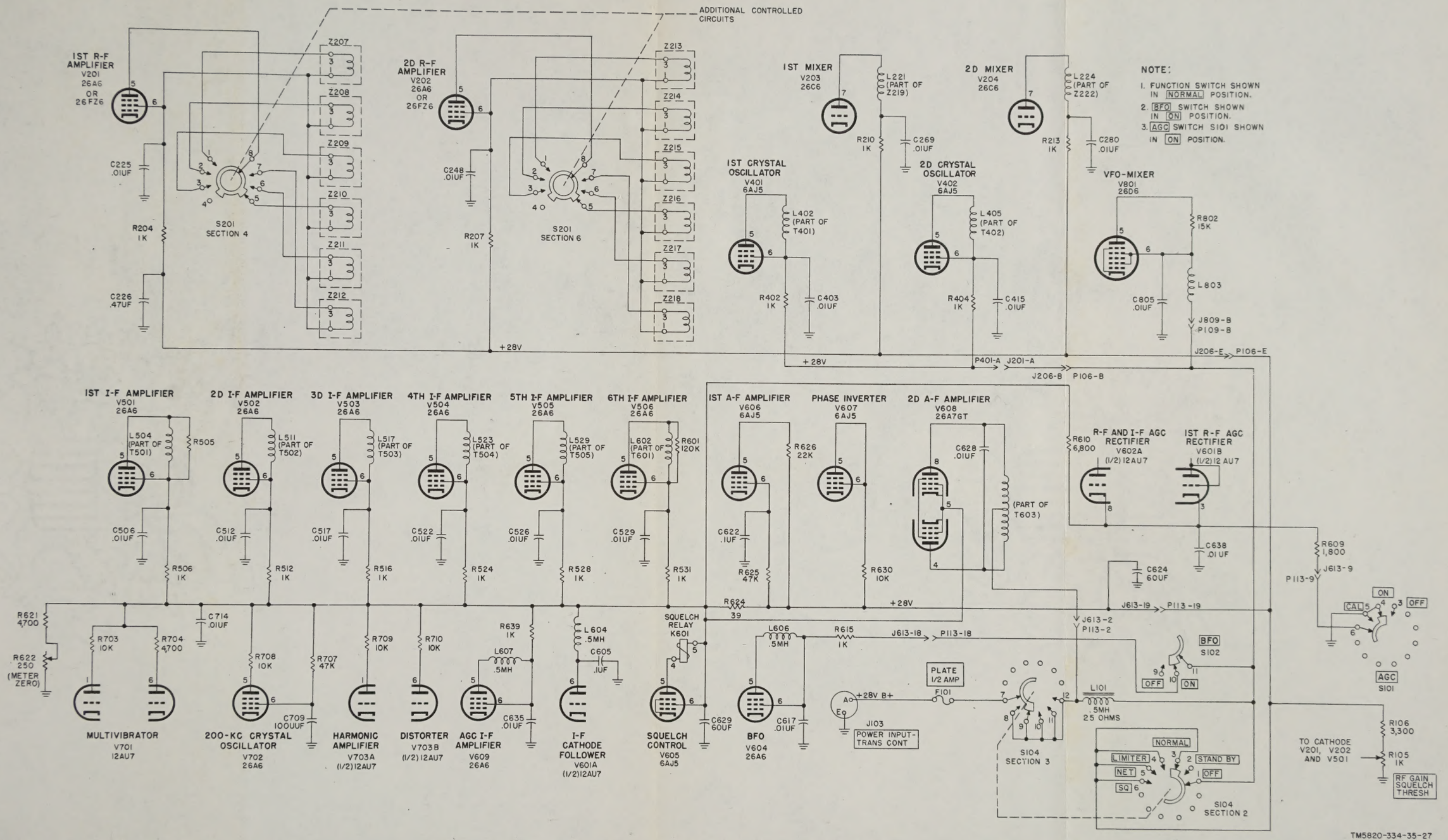
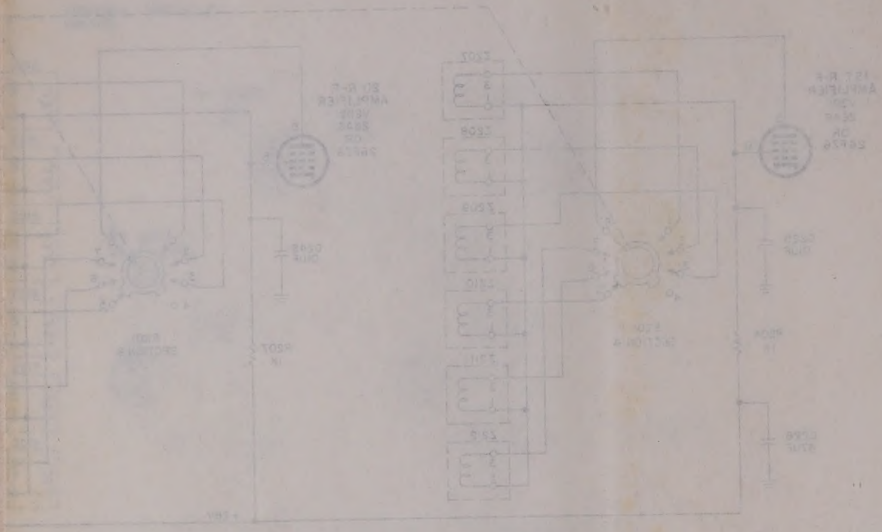
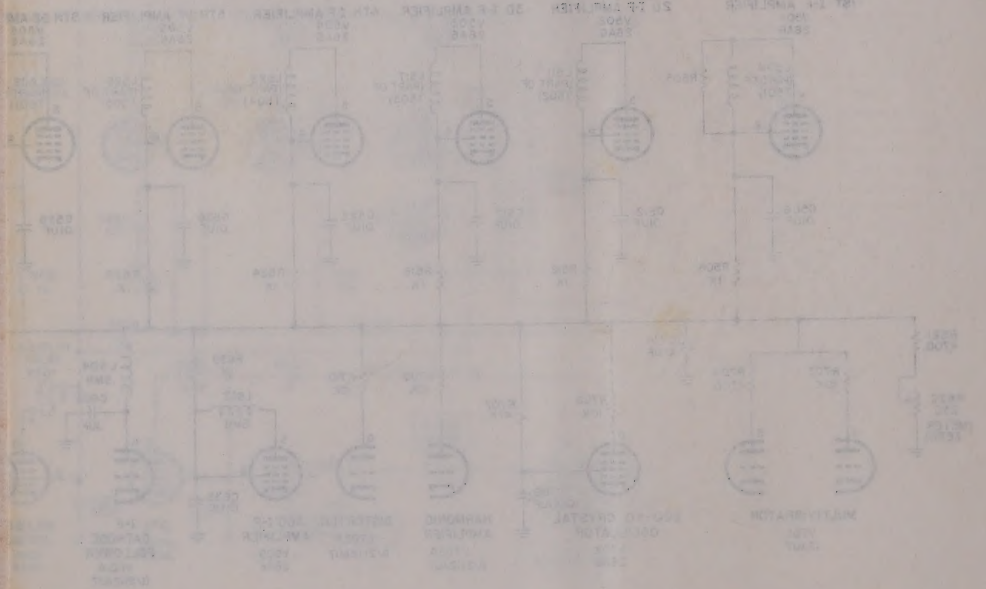


Figure 28. Plate and screen voltage distribution, schematic diagram.





Section III. ANALYSIS OF MECHANICAL TUNING SYSTEM

37. General Principles of Operation (fig. 29)

a. The tuning controls of the receiver vary the permeability-tuning and switch components to provide continuous tuning over a range of 0.5 to 32 mc in 32 bands. Each band is tuned over a 1-mc range except for the first band, which is from 0.5 to 1 mc. The frequency is indicated on a counter-type dial.

b. Rotation of the MEGACYCLES control is limited to 10 turns (three detent positions to a turn) by a mechanical stop. As the control is turned, the first variable if. is varied, through a gear train, from 9 to 18 mc for the tuning range of 0.5 to 8 mc; the first variable if. is electrically disabled on other ranges. At the same time, the switches in the first and second crystal oscillators are rotated through 32 positions and the antenna and rf amplifier slug rack positions are changed (to obtain the megacycle change in electrical tuning) through a differential gear arrangement. The rf bandswitch (6 positions) is operated through a Geneva system and an overtravel coupler.

c. Rotation of the KILOCYCLES control limited to 10 turns by mechanical stop. The control drives the vfo-mixer directly and, through a gear train, drives the first variable if. can rack, the antenna, and rf amplifier (0.5- to 2-mc frequency ranges) slug racks, and the second variable if. slug rack (through a cam at the rear of the 1- to 2-mc if slug rack shaft). The KILOCYCLES control also drives the same differential as the MEGACYCLES control to provide movement of the remaining antenna and rf amplifier slug racks. A DIAL ZERO knob on the front panel permits a small correction between the kilocycle reading on the counter and the electrical setting of the tuning system.

38. Functional Analysis of Tuning System (fig. 30)

a. Figure 30 shows a detailed block diagram of the controlled components in the mechanical tuning system. The frequency-determining elements change at different rates when the tuning system is operated. For example, to cover the 0.5- to 1-mc band, the rf tuning slug rack in Z201, Z207, and Z213 moves from one extreme to the other (approximately 1 inch) while the first variable if. slug rack (Z219, Z220, and Z221) moves less than one-eighth inch. A system of gears under the control of a single knob is used to obtain the different slug rack travel distances.

b. The block diagram shows the circuits controlled by the MEGACYCLES and KILOCYCLES controls. The KILOCYCLES control, operating through a 10-turn stop, varies the position of the vfo-mixer tuning, the second variable if. slug rack, the first variable if. can rack, the 1- to 2-mc slug rack, and the 0.5- to 1-mc slug rack.

c. The MEGACYCLES control, operating through a 10-turn stop and the Geneva system and overtravel coupler, changes the position of rf bandswitch S201. The MEGACYCLES control also selects the proper crystals and oscillator output tuning capacitors for the first and second crystal oscillators by tuning 32-position switch S401 through a group of gears. The 32 bands of the receiver are covered in the antenna circuit and the first and second rf amplifier circuits with six different tuned networks for each circuit. Since each tuned network has a frequency ratio of two-to-one, six networks (switched by S201) provide a full frequency coverage. Synchronization of 6-position switch S201 with 32-position switch S401 is accomplished with the Geneva system. The Geneva system contains a lost-motion gear with a few teeth spaced at intervals around its perimeter. A driven gear associated with the lost-motion gear rotates only when it is engaged by the teeth on the lost-motion gear. The MEGACYCLES control, through the differential, also affects the point at which the motion imparted by the KILOCYCLES control begins. The first variable if. (9 to 18 mc) slug rack is driven by the MEGACYCLES control. The first variable if. cans are mounted on a rack which is

driven by the KILOCYCLES control to keep these circuits in alignment during tuning.

39. Detailed Analysis of Tuning System (fig. 31)

The mechanical schematic diagram of the tuning system illustrates the mechanical parts and their relationship to each other. The placement of the various mechanical components of the tuning system has been illustrated for clarity and association with related text matter and does not necessarily indicate the exact physical placement within the equipment. Gears that are physically mounted together are shown as operating from a common shaft to more clearly illustrate the mechanical action involved. The numbers which appear on the gears in the diagram indicate the number of teeth. The reference symbol callouts (example; 0324, 0297) for gears and shafts are used for identification purposes in the related text. When gears that are physically mounted together are identified with a single reference symbol, the teeth number follows the reference symbol to distinguish between gears (example; 0319 (51), 0319 (30)). The differential and the Geneva system and overtravel coupler components are individually identified with a letter suffix on the reference symbol (example; 0317 (A), 0317 (B)).

a. KILOCYCLES Control.

(1) As the KILOCYCLES control is turned, variable-frequency oscillator drive shaft 0331 is rotated. Antibacklash gear 0329-0330, spur gear 0318, a 10-1/2-turn stop, and an Oldham coupler are mounted on the shaft. The rotation of 0331 is limited to 10-1/2 turns by the 10-1/2-turn stop. The Oldham coupler corrects misalignment between the vfo drive shaft and the vfo tuning shaft.

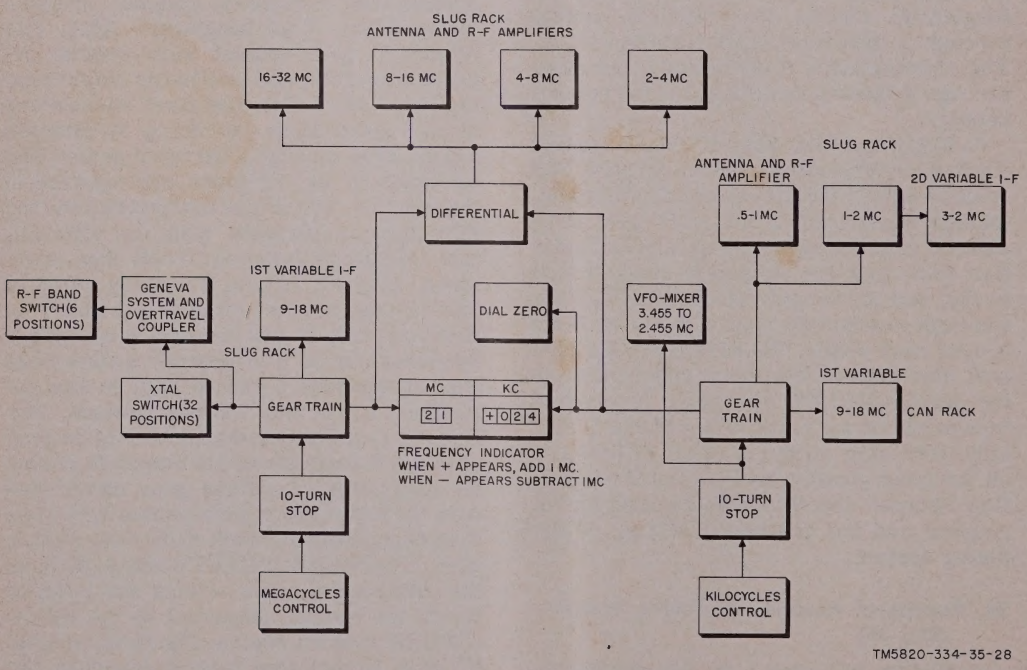
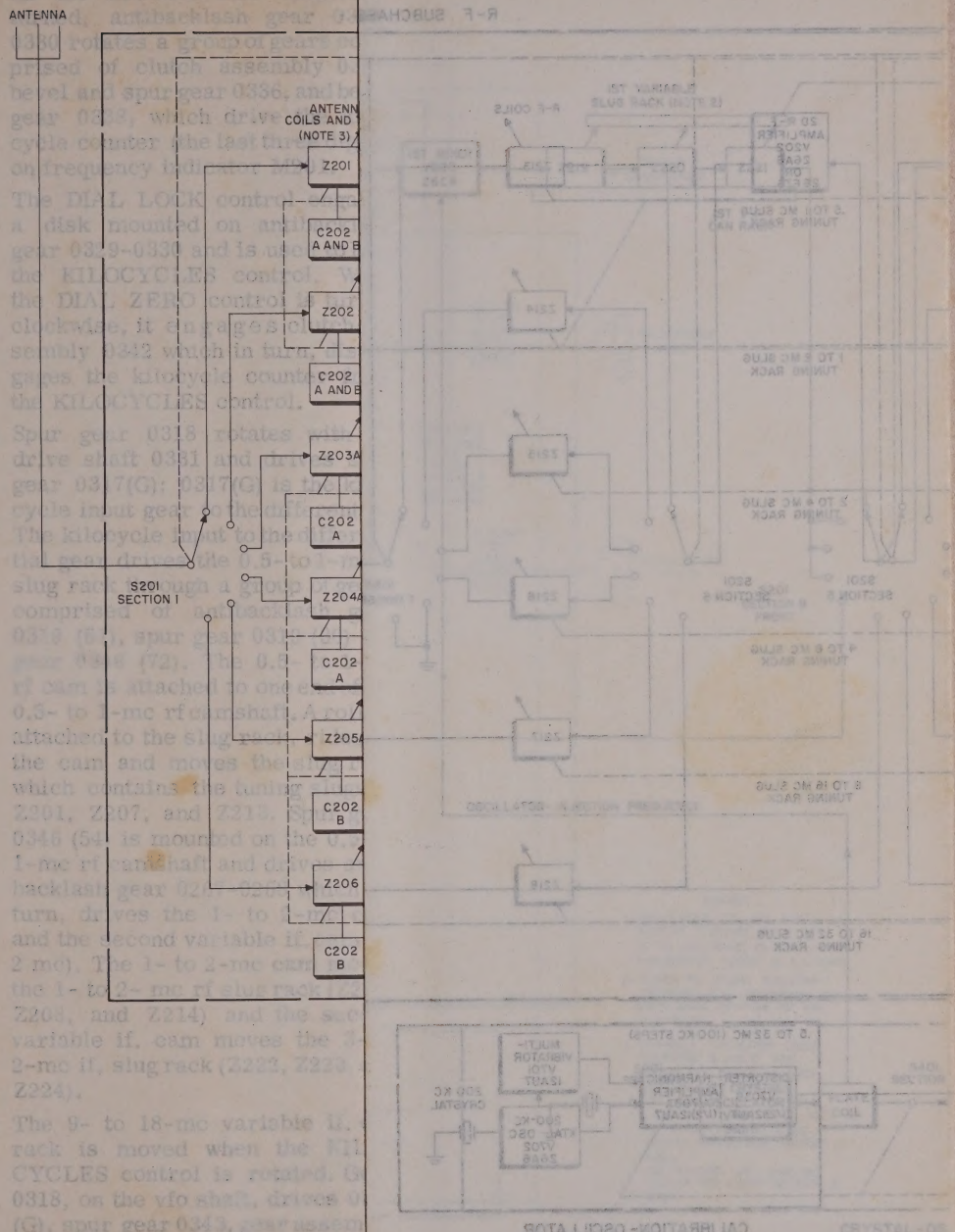


Figure 29. Mechanical tuning system, block diagram.


ANTENNA
ANTENN
COILS AND
(NOTE 3)
Z201
C202
A AND B
Z202
C202
A AND B
Z203A
C202
A
S201
SECTION I
Z204A
C202
A
Z205A
C202
B
Z206
C202
B
CALIBRATION-OSCILLATOR
SUBCHASSIS

driven by the KILOCYCLES control to keep these circuits in alignment during tuning.

39. Detailed Analysis of Tuning System (fig. 31)

The mechanical schematic diagram of the tuning system illustrates the mechanical parts and their relationship to each other. The placement of the various mechanical components of the tuning sys- mechanical components of the tuning system has been illustrated for clarity and association with related text matter and does not necessarily indicate the exact physical placement within the equipment. Gears that are physically mounted together are shown as operating from a common shaft to more clearly illustrate the mechanical action involved. The numbers which appear on the gears in the diagram indicate the number of teeth. The reference symbol callouts (example; 0324, 0297) for gears and shafts are used for identification purposes in the related text. When gears that are physically mounted together are identified with a single reference symbol, the teeth number follows the reference symbol to distinguish between gears (example; 0319 (51), 0319 (30)). The differential and the Geneva system and overtravel coupler components are individually identified with a letter suffix on the reference symbol (example; 0317 (A), 0317 (B)).

a. KILOCYCLES Control.

(1) As the KILOCYCLES control is turned, variable-frequency oscillator drive shaft 0331 is rotated. Antibacklash gear 0329-0330, spur gear 0318, a 10-1/2-turn stop, and an Oldham coupler are mounted on the shaft. The rotation of 0331 is limited to 10-1/2 turns by the 10-1/2-turn stop. The Oldham coupler corrects misalignment between the vfo drive shaft and the vfo tuning shaft.

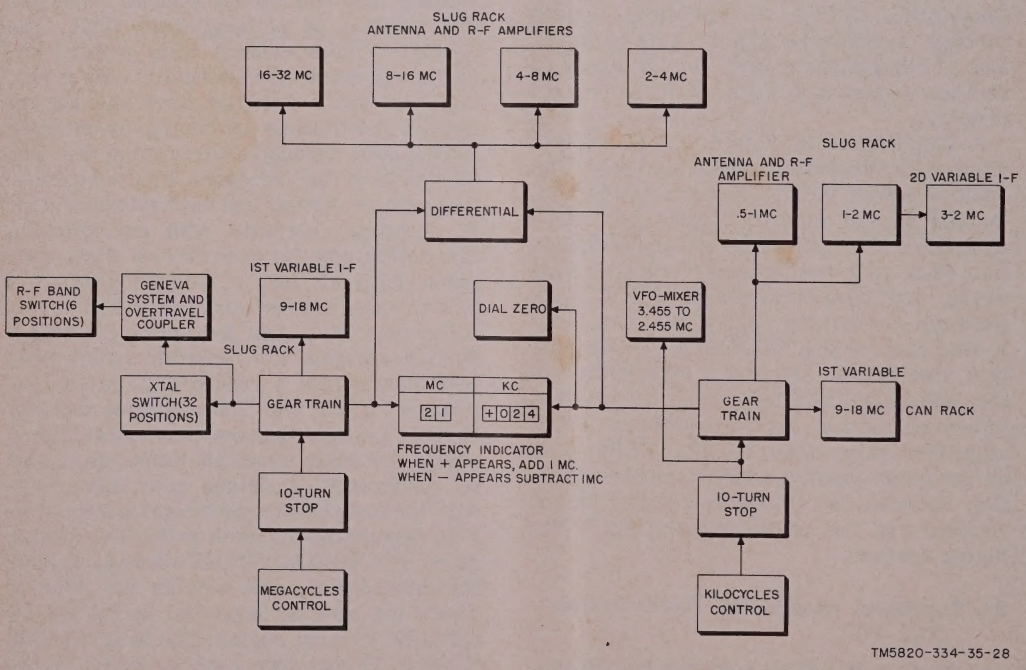
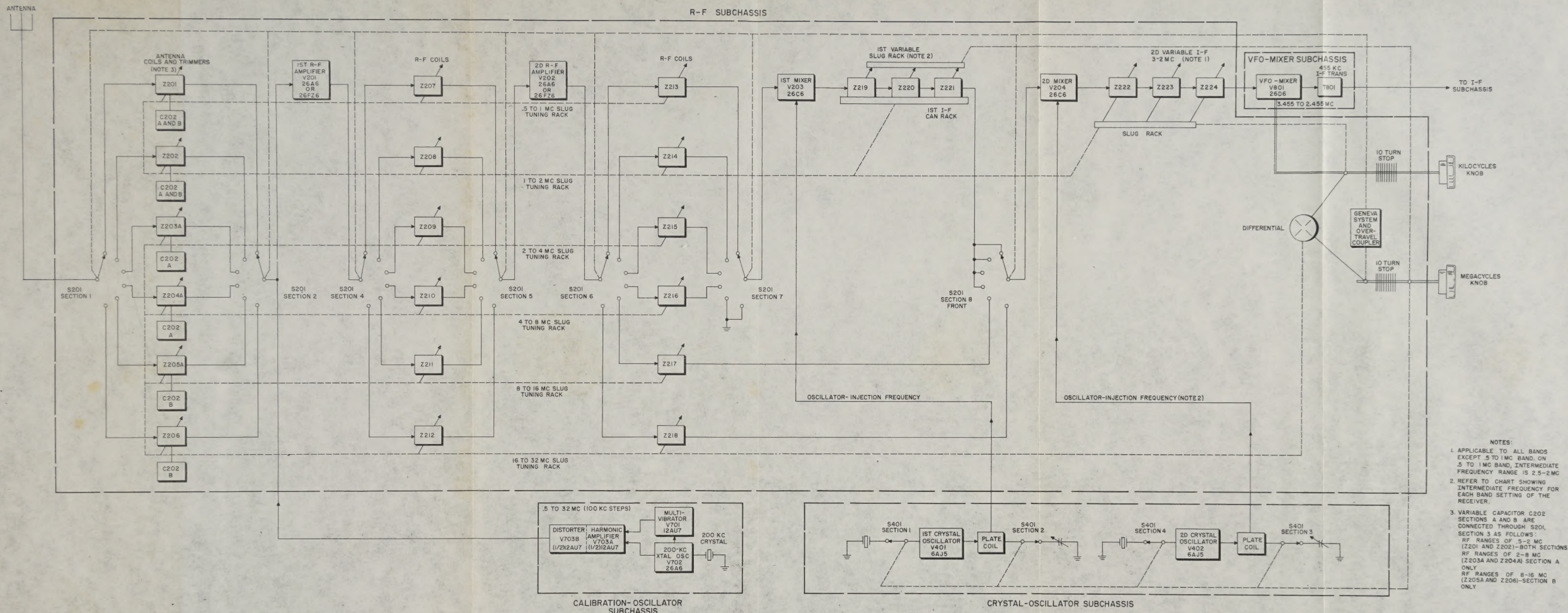


Figure 29. Mechanical tuning system, block diagram.

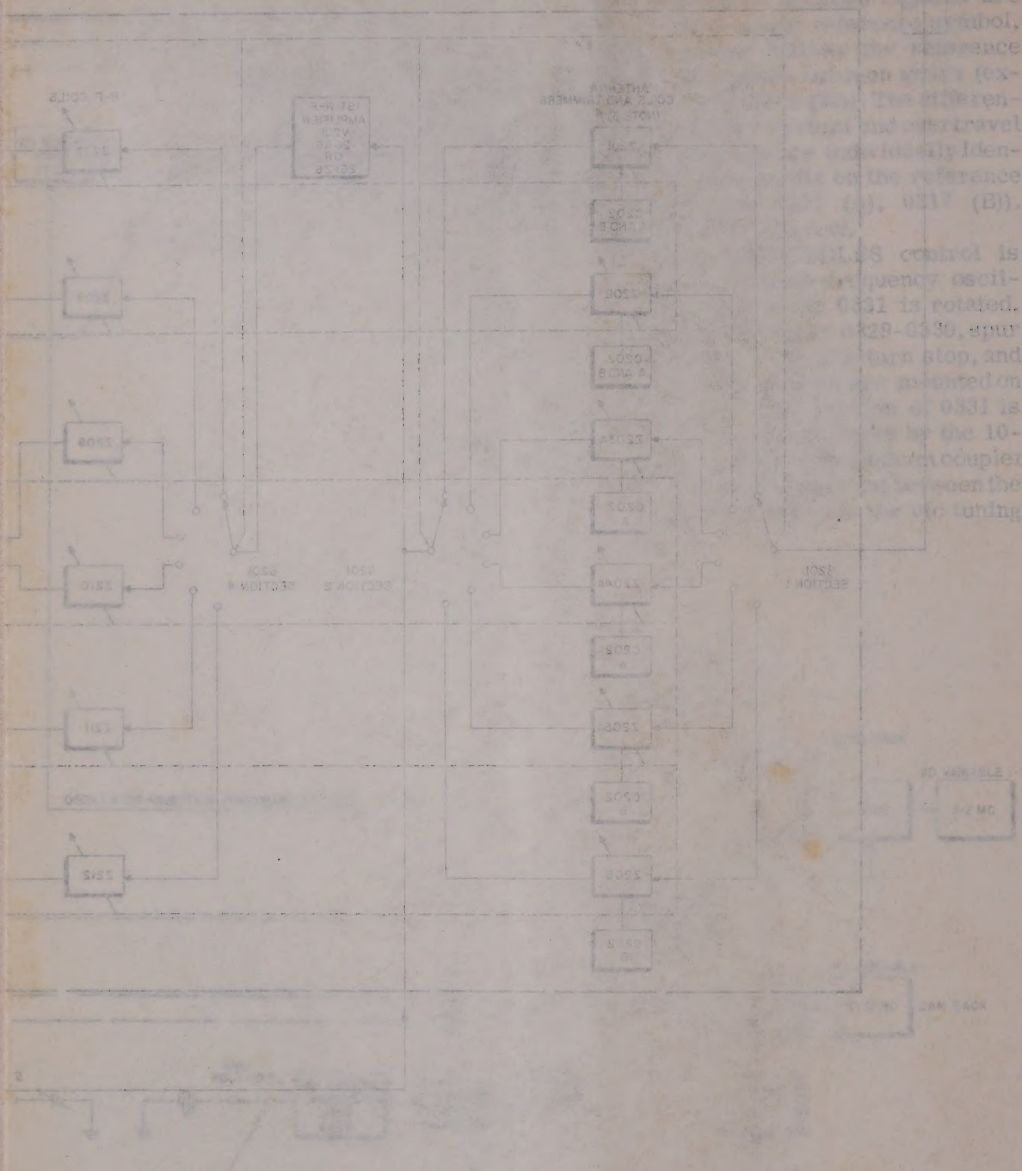


NOTES:

1. APPLICABLE TO ALL BANDS EXCEPT .5 TO 1 MC BAND. ON .5 TO 1 MC BAND, INTERMEDIATE FREQUENCY RANGE IS 2.5–2 MC
2. REFER TO CHART SHOWING INTERMEDIATE FREQUENCY FOR EACH BAND SETTING OF THE RECEIVER.
3. VARIABLE CAPACITOR C202 SECTIONS A AND B ARE CONNECTED THROUGH S201, SECTION 3 AS FOLLOWS:
   RF RANGES OF .5–2 MC (Z201 AND Z202)–BOTH SECTIONS
   RF RANGES OF 2–8 MC (Z203A AND Z204A) SECTION A ONLY
   RF RANGES OF 8–16 MC (Z205A AND Z206)–SECTION B ONLY

TM5820-334-35-29

Figure 30. Tuning system, functional block diagram.



(2) As the KILOCYCLES control is turned, antibacklash gear 0329-0330 rotates a group of gears comprised of clutch assembly 0342, bevel and spur gear 0336, and bevel gear 0338, which drive the kilocycle counter (the last three digits) on frequency indicator M201.

(3) The DIAL LOCK control engages a disk mounted on antibacklash gear 0329-0330 and is used to lock the KILOCYCLES control. When the DIAL ZERO control is turned clockwise, it engages clutch assembly 0342 which in turn, disengages the kilocycle counter from the KILOCYCLES control.

(4) Spur gear 0318 rotates with vfo drive shaft 0331 and drives spur gear 0317(G); 0317(G) is the kilocycle input gear to the differential. The kilocycle input to the differential gear drives the 0.5- to 1-mc rf slug rack through a group of gears comprised of antibacklash gear 0319 (51), spur gear 0319 (30) and gear 0346 (72). The 0.5- to 1-mc rf cam is attached to one end of the 0.5- to 1-mc rf camshaft. A roller, attached to the slug rack, rides on the cam and moves the slug rack which contains the tuning slugs of Z201, Z207, and Z213. Spur gear 0346 (54) is mounted on the 0.5- to 1-mc rf camshaft and drives antibacklash gear 0267-0268 which, in turn, drives the 1- to 2-mc cam and the second variable if. cam (3-2 mc). The 1- to 2-mc cam moves the 1- to 2- mc rf slug rack (Z202, Z208, and Z214) and the second variable if. cam moves the 3- to 2-mc if. slug rack (Z222, Z223, and Z224).

(5) The 9- to 18-mc variable if. can rack is moved when the KILOCYCLES control is rotated. Gear 0318, on the vfo shaft, drives 0317 (G), spur gear 0343, gear assembly 0345, and antibacklash gear 0296-0297, which rotates the first variable if. can rack cam. The first variable if. can is moved by the cam.

b. MEGACYCLES Control.

(1) The MEGACYCLES control turns shaft 0332 which is limited to 10-1/2 turns by a 10-1/2-turn stop. Spur gear 0327, antibacklash gear 0324, and spur gear 0326 are mounted on shaft 0332.

(2) As the MEGACYCLES control is turned, spur gear 0327 drives a group of gears which moves the megacycle counter (the first two digits) on frequency indicator M201. The group of gears is comprised of spur gears 0339, 0340, and 0341 (60), and bevel gears 0341 (24), and 0337.

(3) As MEGACYCLES shaft 0332 is rotated, spur gear 0326 drives gear assembly 0304, gear assembly 0305, and gear 0306. Gear 0306 turns the first variable if. cam which moves the 9- to 18-mc variable if. slug rack.

(4) Gear 0324 drives the megacycles input to differential gear 0317(H). The megacycle input to differential gear 0317(H), rotates the 32-position crystal oscillator switch and the 6-position rf bandswitch through a system of gears. The 32-position crystal oscillator switch, S401, is driven through spur gears 0321, 0323, 0298, 0299, and 0347, shaft 0295, spur gear 0350, and Oldham coupler, and worm 0349. Worm 0349 drives worm wheel 0348 which drives the 32-position crystal switch. The Oldham coupler corrects for misalignment between shaft 0295 and the worm shaft. The 6-position rf bandswitch, S201, is driven through spur gear 0350 on shaft 0295, and drives the Geneva system and overtravel coupler and spur gears 0273 and 0274. Gear 0272(A), on the Geneva system and overtravel coupler, rotates continuously as the MEGACYCLES control is turned; however, spur gears 0273 and 0274 are driven only during the intervals

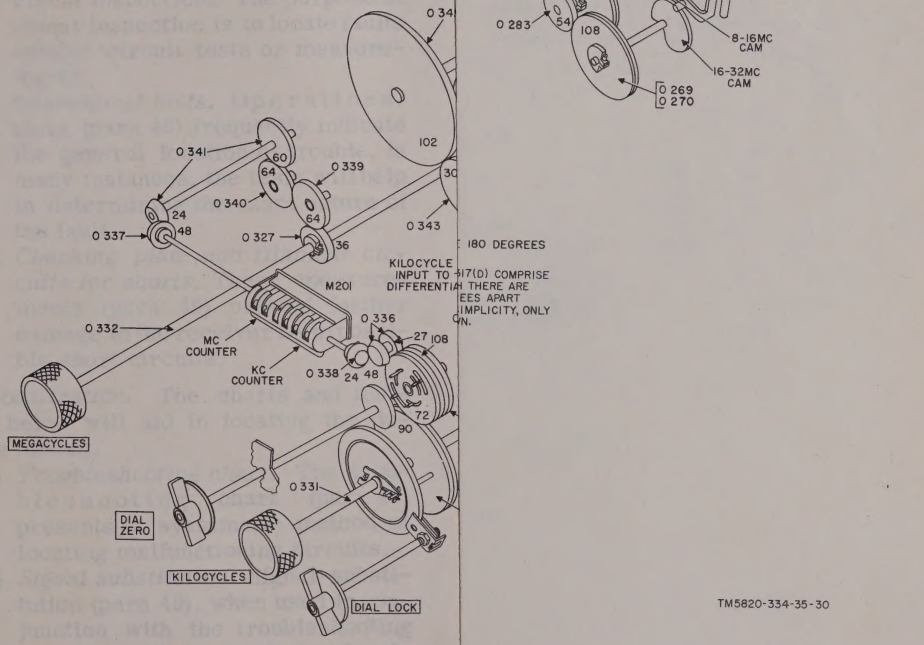
that the teeth of lost motion gear 0272(B) are engaged by spur gear 0273.

c. *Differential Output.*

(1) Rotation of the KILOCYCLES control turns spur gear 0318, which drives gear 0317(G). Rotation of the MEGACYCLES control turns gear 0324, which drives gear 0317(H). As gear 0317(G) is rotated, spur gear 0317(A) is driven which, in turn, drives gear 0317(B), spur gear 0317(C), gear 0317(E), and differential output gear 0317(J). Shaft 0317(D) does not turn as gear 0317(G) is rotated, but the gears mounted on it rotate, disk 0317(F) remains stationary, and gear 0317(H) is not affected. When gear 0317(H) is rotated, shaft 0317(D) is rotated (but not about its own axis). As shaft 0317(D) rotates, spur gear 0317(C) drives gear 0317(E), which rotates the differential output shaft and differential output gear 0317(J).

(2) The differential output gear drives the 2- to 4-mc, 4- to 8-mc, 8- to 16-mc, and the 16- to 32-mc rf slug racks through a gear train composed of gear 0308, antibacklash gear 0311-0309, antibacklash gear 0309-0310, gear 0312, gear 0316, antibacklash gear 0280, spur gear 0281, antibacklash gear 0282, spur gear 0283, and antibacklash gear 0269-0270.

(3) The MEGACYCLES control must set the circuit elements at an exact position for each band of frequency coverage. This requirement is met with the MEGACYCLES control detent. Detent disk 0317(F) has three notches spaced equally around its perimeter; the disk is rotated by gear 0317(H) and antibacklash gear 0324. An L-shaped bracket, made of spring metal, presses against the disk and produces an effective stop at each notch.


2-4 MC R-F SLUG RACK
4-8MC R-F SLUG RACK
8-16 MC R-F SLUG RACK
16-32MC R-F SLUG RACK
4-8MC CAM
2-4MC CAM
8-16MC CAM
16-32MC CAM
Z203A
Z209
Z215
Z204A
Z210
Z216
Z211
Z217
Z205A
Z206
Z212
Z218
0 317J
0 308
0 311
0 316
0 280
0 296
0 281
0 282
0 283
0 269
0 270
0 341
0 339
0 340
0 337
0 327
0 343
0 332
0 336
0 338
0 331
M201
MC COUNTER
KC COUNTER
MEGACYCLES
DIAL ZERO
KILOCYCLES
DIAL LOCK
180 DEGREES
KILOCYCLE INPUT TO
DIFFERENTIA
THERE ARE
EES APART
IMPLICITY, ONLY
ON.
317(D) COMPRISE

that the teeth of lost motion gear 0272(B) are engaged by spur gear 0273.

c. *Differential Output.*

(1) Rotation of the KILOCYCLES control turns spur gear 0318, which drives gear 0317(G). Rotation of the MEGACYCLES control turns gear 0324, which drives gear 0317(H). As gear 0317(G) is rotated, spur gear 0317(A) is driven which, in turn, drives gear 0317(B), spur gear 0317(C), gear 0317(E), and differential output gear 0317(J). Shaft 0317(D) does not turn as gear 0317(G) is rotated, but the gears mounted on it rotate, disk 0317(F) remains stationary, and gear 0317(H) is not affected. When gear 0317(H) is rotated, shaft 0317(D) is rotated (but not about its own axis). As shaft 0317(D) rotates, spur gear 0317(C) drives gear 0317(E), which rotates the differential output shaft and differential output gear 0317(J).

(2) The differential output gear drives the 2- to 4-mc, 4- to 8-mc, 8- to 16-mc, and the 16- to 32-mc rf slug racks through a gear train composed of gear 0308, antibacklash gear 0311-0309, antibacklash gear 0309-0310, gear 0312, gear 0316, antibacklash gear 0280, spur gear 0281, antibacklash gear 0282, spur gear 0283, and antibacklash gear 0269-0270.

(3) The MEGACYCLES control must set the circuit elements at an exact position for each band of frequency coverage. This requirement is met with the MEGACYCLES control detent. Detent disk 0317(F) has three notches spaced equally around its perimeter; the disk is rotated by gear 0317(H) and antibacklash gear 0324. An L-shaped bracket, made of spring metal, presses against the disk and produces an effective stop at each notch.

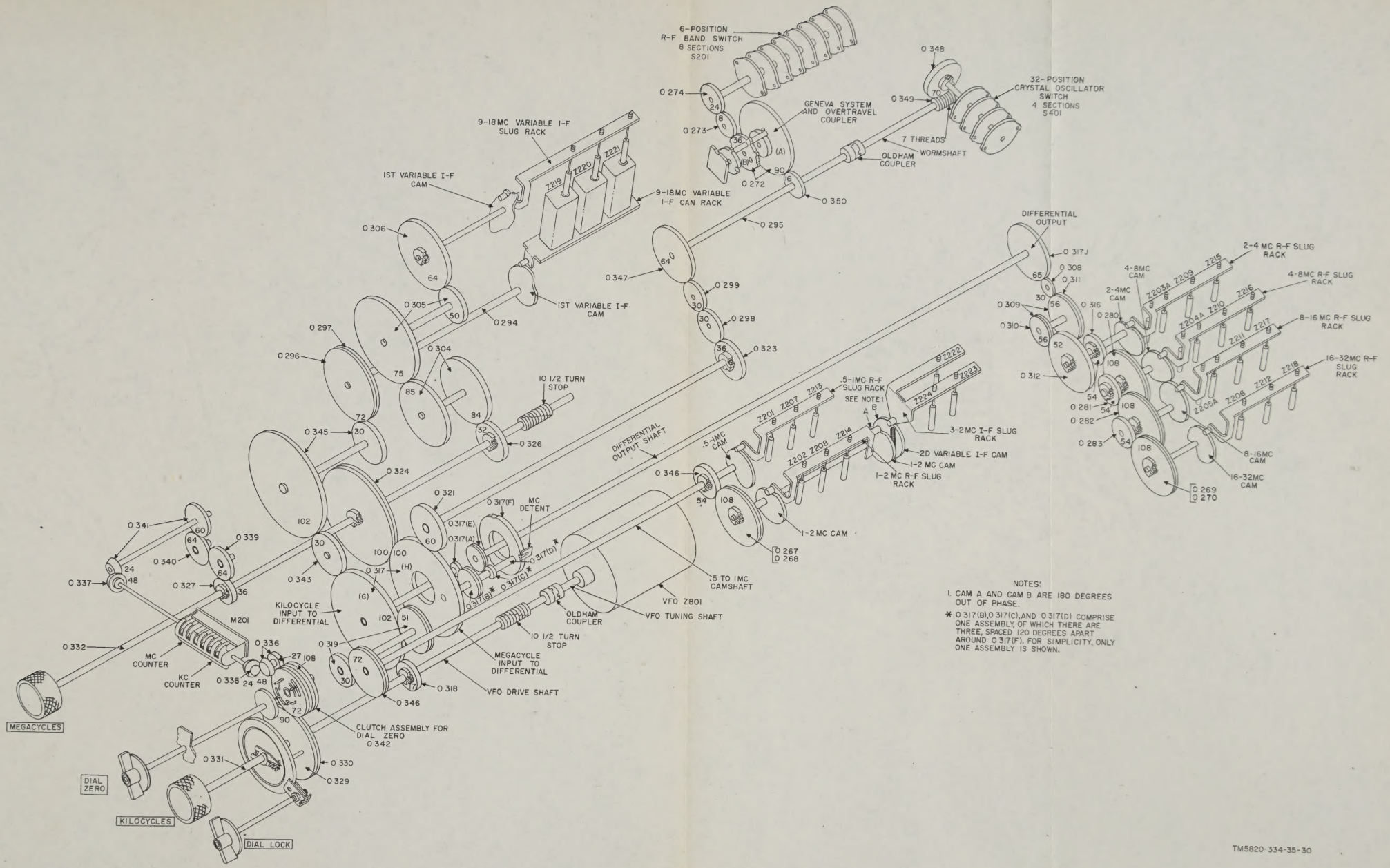
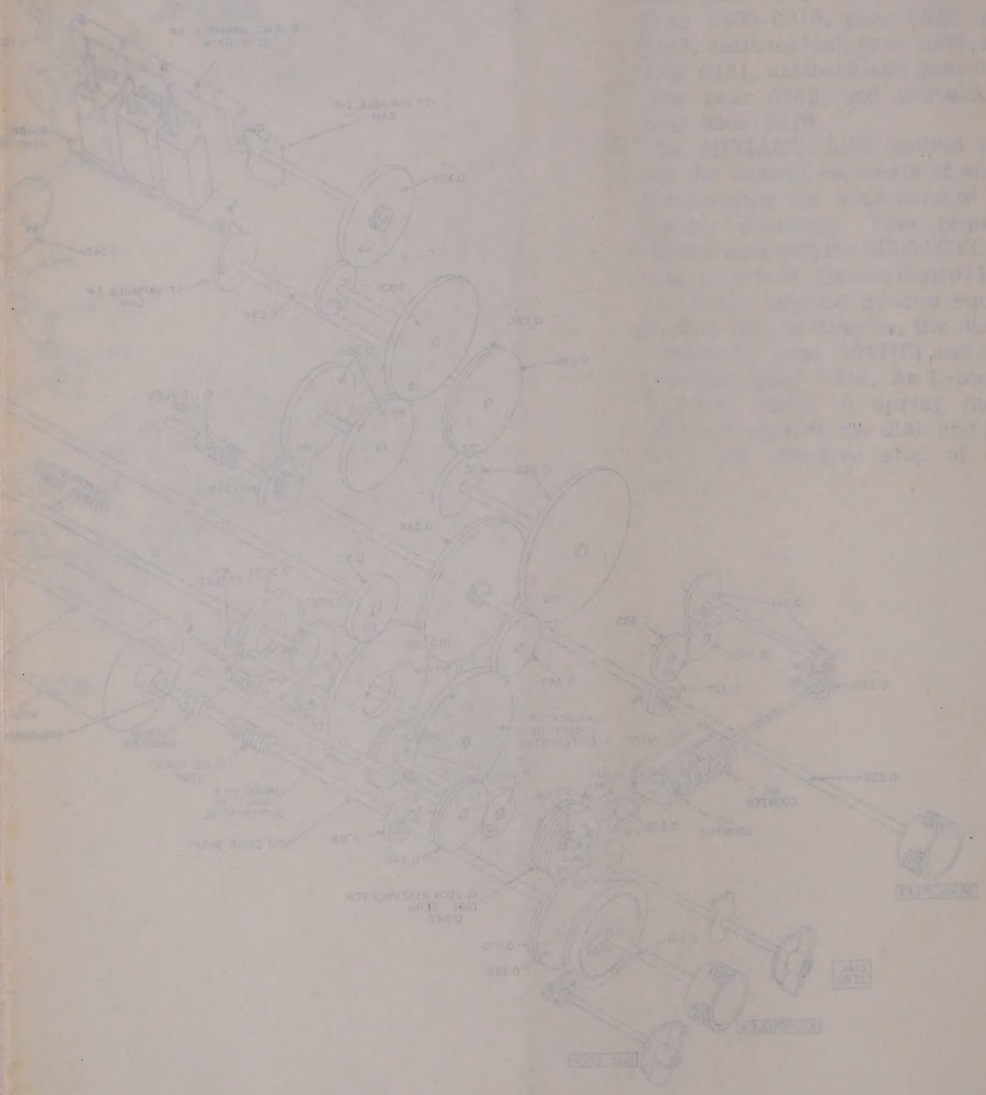


Figure 31. Tuning system, mechanical schematic.



CHAPTER 2

TROUBLESHOOTING

Note. All troubleshooting may be performed by third echelon maintenance personnel unless otherwise noted.

40. Troubleshooting Procedures

a. General. The first step in servicing a defective receiver is to sectionalize the fault. Sectionalization consists of tracing the fault to the subchassis responsible for the abnormal operation of the receiver. The second step is to localize the fault. Localization means tracing the fault to the malfunctioning circuit in the subchassis. Finally, the defective part is isolated by voltage and resistance measurements.

b. Sectionalization. Listed below is a group of tests arranged to aid in locating the defect to a subchassis.

(1) *Visual inspection.* The purpose of visual inspection is to locate faults without circuit tests or measurements.

(2) *Operational tests.* Operational tests (para 46) frequently indicate the general location of trouble. In many instances, the tests will help in determining the exact nature of the fault.

(3) *Checking plate and filament circuits for shorts.* These measurements (para 45) prevent further damage to the receiver from possible short circuits.

c. Localization. The charts and tests listed below will aid in locating the defective circuit.

(1) *Troubleshooting chart.* The troubleshooting chart (para 47) presents a systematic method of locating malfunctioning circuits.

(2) *Signal substitution.* Signal-substitution (para 49), when used in conjunction with the troubleshooting chart, provides a method of localizing trouble to a stage.

(3) *Stage-gain charts.* These charts (para 54) are helpful in localizing obscure, hard-to-find troubles.

d. Isolation. The defective component is usually located by voltage and resistance measurements. Voltage and resistance charts (fig. 78, 79, and 80), and paragraph 56 will aid in locating the defective component. The resistor and capacitor color codes are given in figure 76 and 77.

Note. Intermittents. In all these tests, the possibility of intermittents should not be overlooked. This type of trouble may be made to appear by tapping or jarring the subchassis or parts under test. It is possible that the trouble is not in the receiver but in the installation (mounting, antenna, ground connection, vehicle, or other associated equipment.

41. Bench Testing
(fig. 32, 33, and 34)

a. When a cause of equipment failure has been sectionalized to a subchassis, a bench test of the faulty subchassis and use of the troubleshooting chart may be required to locate the trouble. Because the undersides of the subchassis are not accessible for troubleshooting when the subchassis are mounted in the receiver, it may be necessary to remove the subchassis. Most bench testing can be performed by removing the lower deck assembly from the receiver and connecting extension cable No. 1 between P810 from the vfo subchassis and J510 on the if. subchassis (fig. 32). It may sometimes be necessary to remove the subchassis under test and connect them to the receiver circuits by the use of extension cables. Directions for the fabrication of extension cables are given in figures 33 and 34.

b. To prepare a subchassis for bench testing, remove it from the receiver according to the instructions contained in paragraphs 58 through 65. Connect the extension cables, if necessary, between the receiver and subchassis according to the following chart.

Subchassis or assembly	Extension cable No.	Connect between	Fig. No.
Rf			
Rf to front panel	3	J206-P106	54
Rf to crystal oscillator	4	J201-P401	57
Crystal oscillator to rf	1A	P402-J202	57
Vfo to rf	1A	J808-P208	53
Rf to front panel	1A	P206-J106	54
Crystal oscillator to rf	1A	P402-J202	57
Crystal oscillator			
Crystal oscillator to rf	4	P401-J201	57
Crystal oscillator to rf	1A	P403-J203	57
Crystal oscillator to rf	1A	P402-J202	57
Vfo			
Vfo to front panel	4	J809-P109	53
Vfo to rf	1A	J808-P208	53
Vfo to if.	1	P810-J510	53
Lower deck assembly			
Af to front panel	2	J613-P113	53
Front panel to af	1	P111-J611	53
Front panel to af	1	P112-J612	53
Vfo to if.	1	P810-J510	53

42. General Precautions

Whenever a receiver is to be serviced, observe the following precautions.

a. Be sure that the receiver is disconnected from the power source or is turned off before contacting exposed circuits or changing connections.

b. After removal of a subchassis, do not turn the shafts or tuning controls unless it is necessary for troubleshooting or adjustment. Careful handling may eliminate the need for synchronization procedures. When removing a subchassis, note the position of the front panel controls, because a control may be turned during servicing.

c. Careless replacement of parts often produces new faults. To prevent further damage, note the following precautions.

(1) Note the position of the leads before unsoldering a part. If the part has a number of connections, tag each of its leads.

(2) Be careful not to damage other leads while pulling or pushing them out of the way.

(3) Do not allow drops of solder to fall into the receiver; they may cause short circuits.

d. In receivers using the transistorized audio module in the audio subchassis, do not troubleshoot by shorting various points to ground and listening for a *click;* transistors may become permanently damaged.

43. Visual Inspection

When a receiver is brought in for a check or repairs, remove the receiver from its case (para 60) and in addition to the items listed for organizational maintenance (TM 11-5820-334-20), inspect the following:

a. Resistors and insulation for signs of overheating. Check for wax leakage and discoloration of components.

b. Tube sockets, plugs, and other components for broken connections.

c. Bare wires for shorts to chassis or adjoining wires.

d. Fuses for correct rating and type.

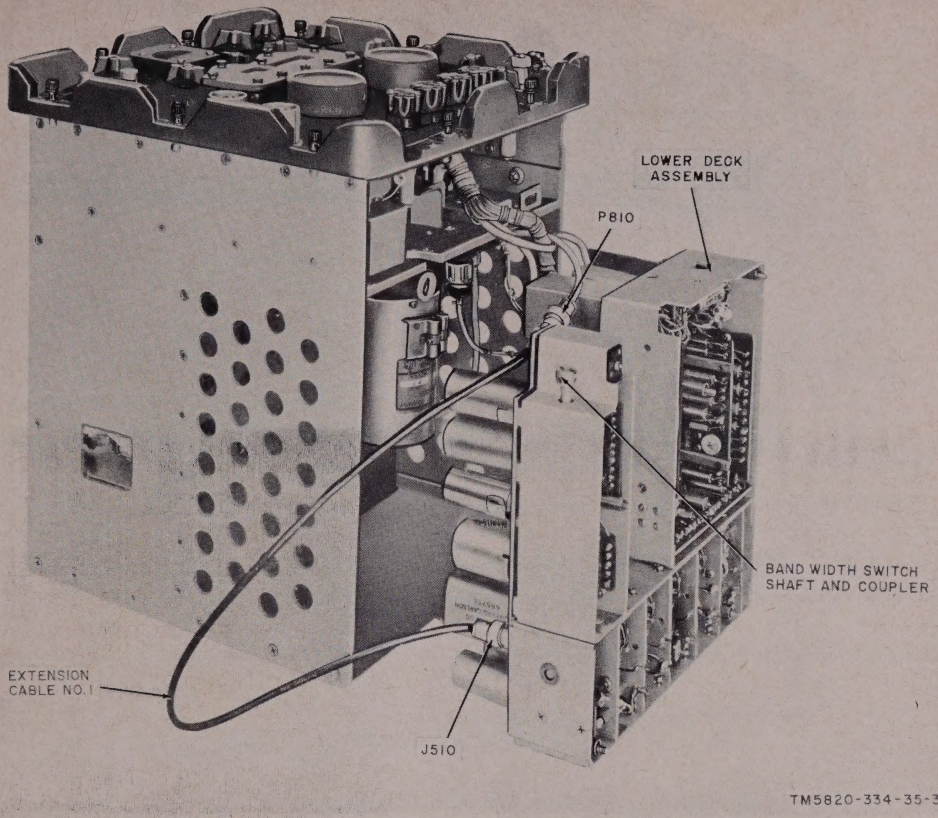


Figure 32. Bench test, lower deck assembly removed.

Check for short circuits (para 45) when a blown fuse is found.

e. MEGACYCLES and KILOCYCLES controls for rough operation or binding. Roughness of tuning mechanism operation indicates need for cleaning and lubrication (para 69 and 70) or a damaged tuning system.

f. Switches and controls for ease of operation.

44. Test Equipment Required

The following chart lists test equipment required for troubleshooting Radio Receiver R-392/URR. The chart also lists the associated technical manuals for the test equipment.

Test equipment	Technical manual
Audio Oscillator TS-382/U	TM 11-2684
Multimeter, Meter ME-26/U	TM 11-6625-200-12
Multimeter, TS-352/U	TM 11-5527
Oscilloscope AN/USM-50	TM 11-5129
Rf Signal Generator AN/URM-25	TM 11-5551
Test Set, Electron Tube TV-7/U	TM 11-6625-274-12

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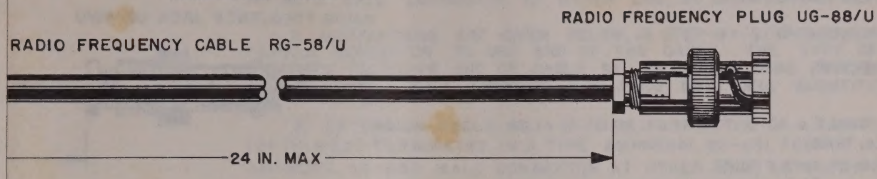
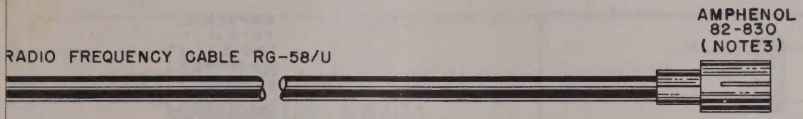
COMPLETED CABLE NO.1





COMPLETED CABLE NO.1A

	WITH SLEEVE IN PLACE, COMB OUT BRAID, FOLD BACK SMOOTH AS SHOWN, AND TRIM 3/32".
	BARE CENTER CONDUCTOR 1/8" — *DON'T NICK CONDUCTOR.*
ALE CONTACT	TIN CENTER CONDUCTOR OF CABLE. SLIP FEMALE CONTACT IN PLACE AND SOLDER. REMOVE EXCESS SOLDER. *BE SURE CABLE DIELECTRIC IS NOT HEATED EXCESSIVELY AND SWOLLEN SO AS TO PREVENT DIELECTRIC ENTERING BODY.*
JACK BODY	PUSH INTO BODY AS FAR AS IT WILL GO. SLIDE NUT INTO BODY AND SCREW INTO PLACE, WITH WRENCH, UNTIL MODERATELY TIGHT. HOLD CABLE AND SHELL RIGIDLY AND ROTATE NUT.
	ASSEMBLED CONNECTOR.

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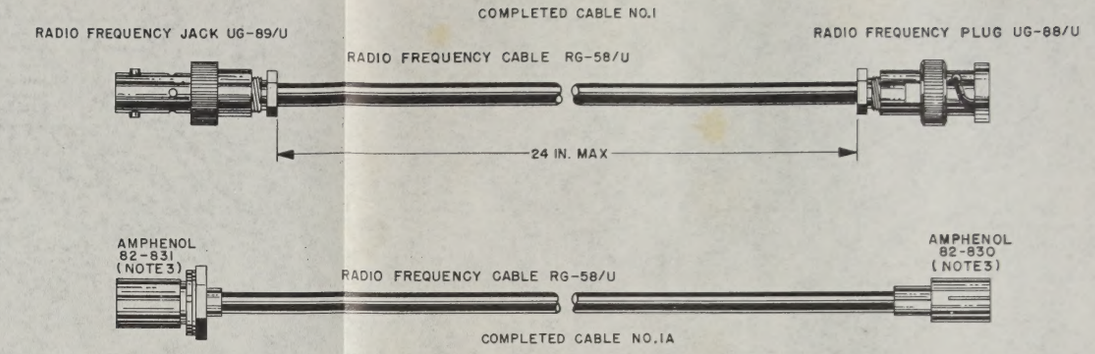
ASSEMBLY INSTRUCTIONS FOR CABLE NO. 1 AND NO. 1A

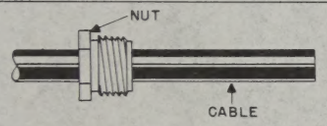
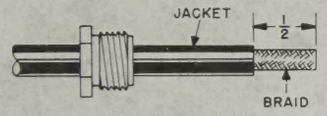
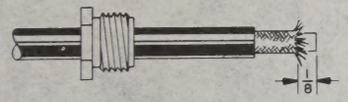
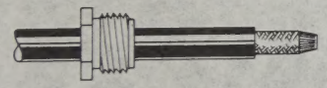
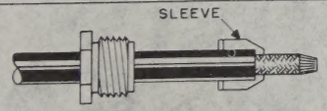
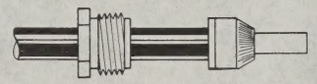
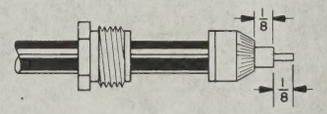
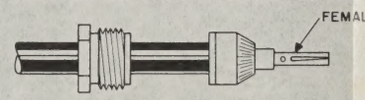
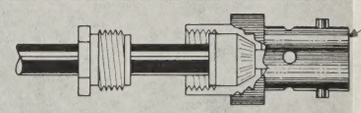
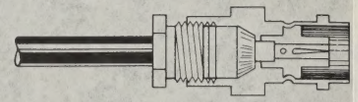
1. EXTENSION CABLE NO.1 IS TO BE FABRICATED OF A LENGTH OF RG-58C/U COAXIAL CABLE (24 IN. MAX) TERMINATED IN A TYPE UG-89/U FEMALE CONNECTOR AT ONE END AND A TYPE UG-88/U MALE CONNECTOR AT OTHER END, AS SHOWN IN UPPER RIGHT-HAND SECTOR OF THIS FIGURE.

2. INSTRUCTIONS ARE GIVEN BELOW, IN STEP-BY-STEP SEQUENCE, FOR ATTACHING THE TYPE UG-89/U FEMALE CONNECTOR TO ONE END OF THE CABLE. THE TYPE UG-88/U MALE CONNECTOR IS ATTACHED TO OTHER END OF CABLE BY FOLLOWING SAME PROCEDURE AS FOR FEMALE CONNECTOR, EXCEPT THAT A MALE CONTACT AND PLUG BODY ARE SUBSTITUTED.

3. EXTENSION CABLE NO.1A IS TO BE FABRICATED OF A LENGTH OF RG-58A/U COAXIAL CABLE (24 IN. MAX) TERMINATED IN A TYPE AMPHENOL 82-831 FEMALE CONNECTOR AT ONE END AND A TYPE AMPHENOL 82-830 MALE CONNECTOR AT OTHER END, AS SHOWN IN UPPER RIGHT-HAND SECTOR OF THIS FIGURE.

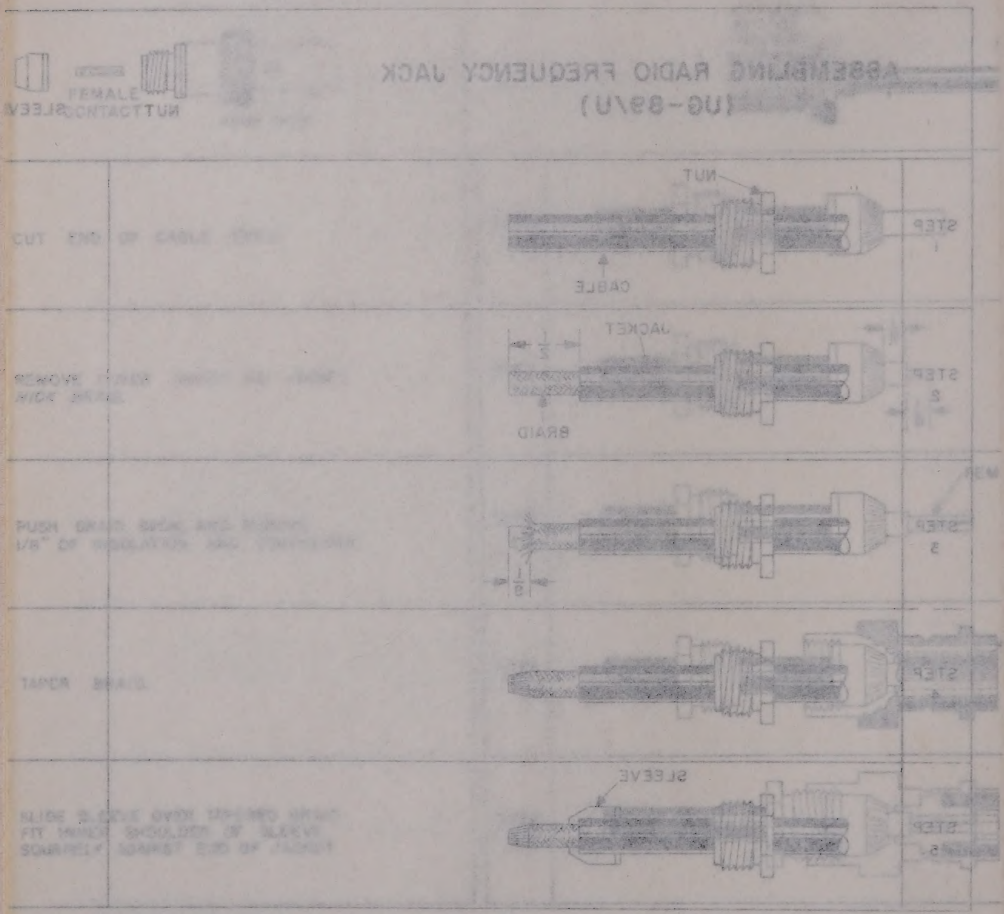


ASSEMBLING RADIO FREQUENCY JACK (UG-89/U)

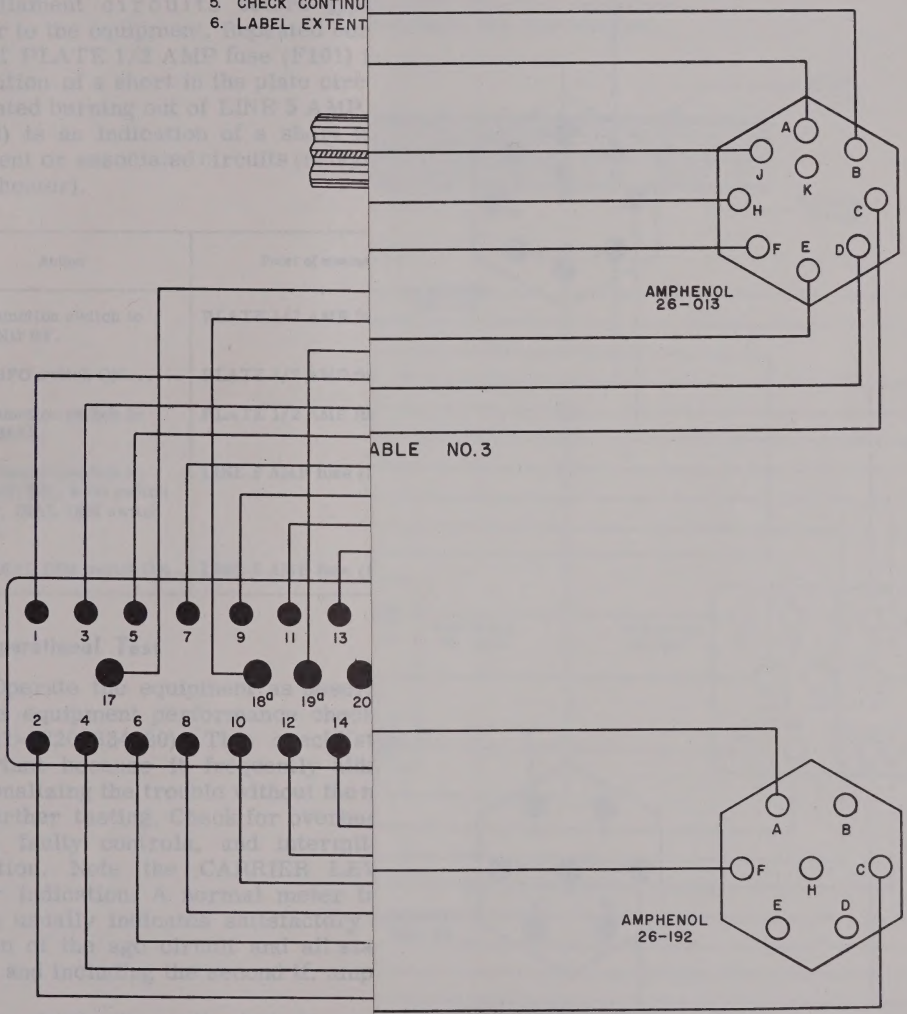
STEP 1		CUT END OF CABLE EVEN.
STEP 2		REMOVE OUTER JACKET 1/2"—*DON'T NICK BRAID.*
STEP 3		PUSH BRAID BACK, AND REMOVE 1/8" OF INSULATION AND CONDUCTOR.
STEP 4		TAPER BRAID.
STEP 5		SLIDE SLEEVE OVER TAPERED BRAID. FIT INNER SHOULDER OF SLEEVE SQUARELY AGAINST END OF JACKET.
STEP 6		WITH SLEEVE IN PLACE, COMB OUT BRAID, FOLD BACK SMOOTH AS SHOWN, AND TRIM 3/32".
STEP 7		BARE CENTER CONDUCTOR 1/8"—*DON'T NICK CONDUCTOR.*
STEP 8		TIN CENTER CONDUCTOR OF CABLE. SLIP FEMALE CONTACT IN PLACE AND SOLDER. REMOVE EXCESS SOLDER. *BE SURE CABLE DIELECTRIC IS NOT HEATED EXCESSIVELY AND SWOLLEN SO AS TO PREVENT DIELECTRIC ENTERING BODY.*
STEP 9		PUSH INTO BODY AS FAR AS IT WILL GO. SLIDE NUT INTO BODY AND SCREW INTO PLACE, WITH WRENCH, UNTIL MODERATELY TIGHT. HOLD CABLE AND SHELL RIGIDLY AND ROTATE NUT.
STEP 10		ASSEMBLED CONNECTOR.

TM5820-334-35-31

Figure 33. Cable No. 1 and 1A, assembly instructions.


FEMALE CONTACT
NUT
SLEEVE
NUT
CABLE
STEP 1
JACKET
BRAID
STEP 2
STEP 3
SLEEVE
STEP 4
STEP 5

1. THE MULTICONDU
FABRICATED OF
WIRE (SUPRENE
, NO. 18 GAGE
AND NO. 22 GAG
INSULATION MU
2. CONNECTORS SH
WITH FEMALE
WITH 26-192
3. CABLES TO BE
SHOWN IN INSE
4. MAXIMUM LENG
5. CHECK CONTINU
6. LABEL EXTENT



ABLE NO.3

CABLE NO.4

TM5820-334-35-32

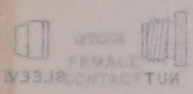
ASSEMBLY INSTRUCTIONS FOR CABLE

1. EXTENSION CABLE NO.1 IS TO BE FABRICATED OF A LENGTH OF RG-58 (24 IN. MAX) TERMINATED IN A TYPE UG-89/U FEMALE CONNECTOR AT ONE END UG-88/U MALE CONNECTOR AT OTHER END, AS SHOWN IN UPPER RIGHT HAND

2. INSTRUCTIONS ARE GIVEN BELOW IN STEP-BY-STEP SEQUENCE, FOR ATTA FEMALE CONNECTOR TO ONE END OF THE CABLE. THE TYPE UG-88/U MALE ATTACHED TO OTHER END OF CABLE BY FOLLOWING SAME PROCEDURES AS FOR EXCEPT THAT A MALE CONTACT AND PLUG BODY ARE SUBSTITUTED.

3. EXTENSION CABLE NO.1A IS TO BE FABRICATED OF A LENGTH OF RG-58 (24 IN. MAX) TERMINATED IN A TYPE AMPHENOL 82-831 FEMALE CONNECTOR AT AMPHENOL 82-830 MALE CONNECTOR AT OTHER END, AS SHOWN IN UPPER RIGHT

ASSEMBLING RADIO FREQUENCY JACK (UG-89/U)



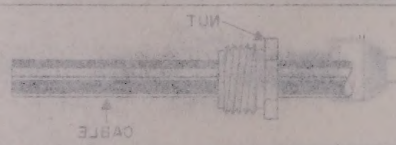
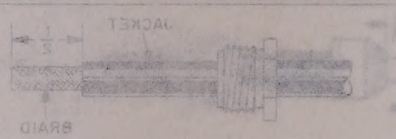
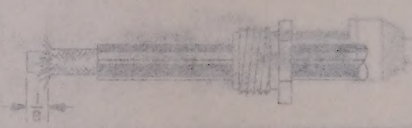
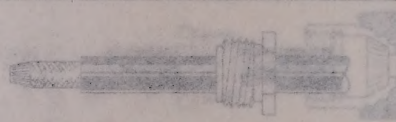
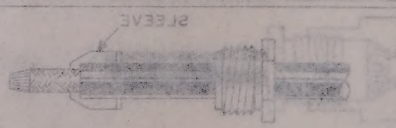
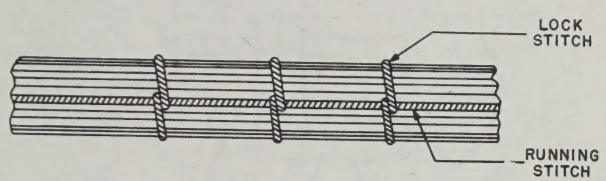
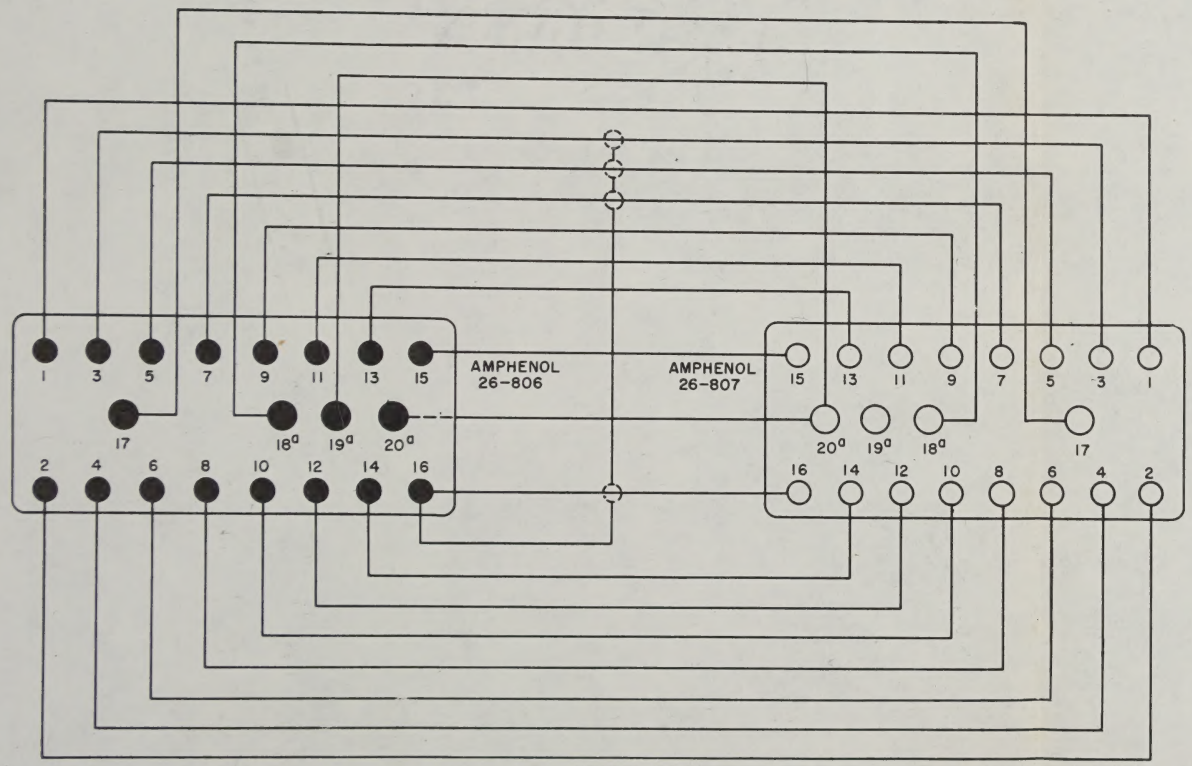
CUT END OF CABLE [illegible]		STEP 1
REMOVE OUTER [illegible] NICK BRAID		STEP 2
PUSH BRAID BACK AND [illegible] 1/8" OF INSULATION [illegible]		STEP 3
TAPER BRAID		STEP 4
SLIDE SLEEVE OVER [illegible] FIT INNER SHOULDER OF [illegible] SQUARELY AGAINST END OF [illegible]		STEP 5

Figure 25. [illegible] instructions.

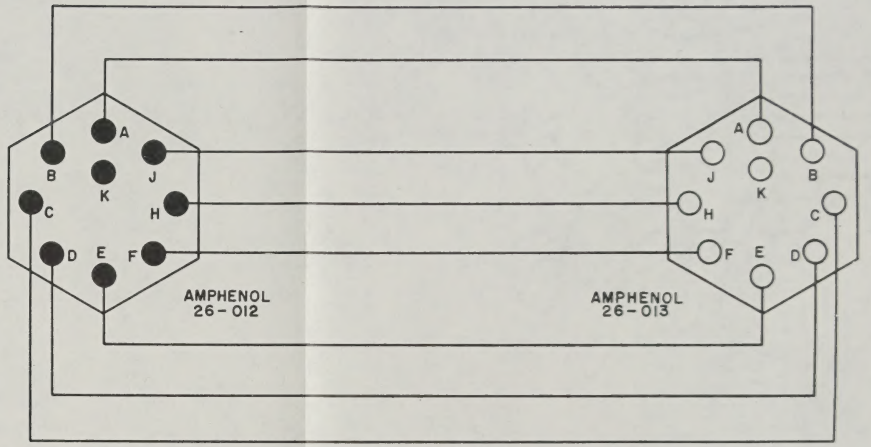
NOTES:

1. THE MULTICONDUCTOR EXTENTION CABLES ARE TO BE FABRICATED OF NO. 18 TO 22 GAGE SHIELDED, STRANDED WIRE (SUPRENENT) FOR AUDIO CONDUCTORS INDICATED BY ○, NO. 18 GAGE STRANDED WIRE FOR CONDUCTORS MARKED a, AND NO. 22 GAGE STRANDED WIRE FOR ALL OTHER CONDUCTORS. INSULATION MUST BE RATED AT 600V.
2. CONNECTORS SHOWN VIEWED FROM REAR. COVERS TO BE USED WITH FEMALE CONNECTORS. AMPHENOL 86-834 COVER USED WITH 26-192 CONNECTOR.
3. CABLES TO BE LACED WITH NO.6 VINYLITE LACING CORD AS SHOWN IN INSERT.
4. MAXIMUM LENGTH OF ALL CABLES IS 24 INCHES.
5. CHECK CONTINUITY AFTER COMPLETING FABRICATION.
6. LABEL EXTENTION CABLES FOR IDENTIFICATION.

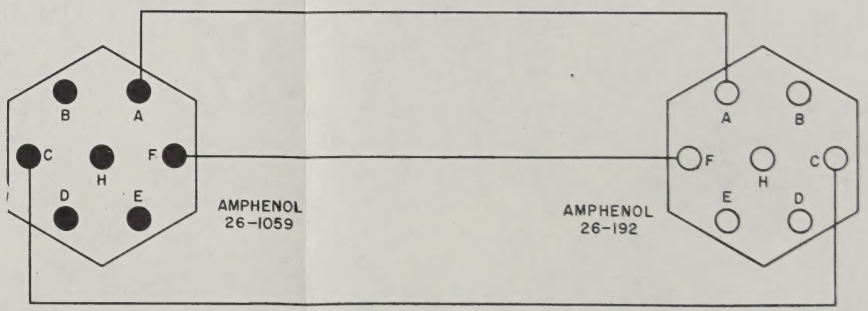




CABLE NO. 2



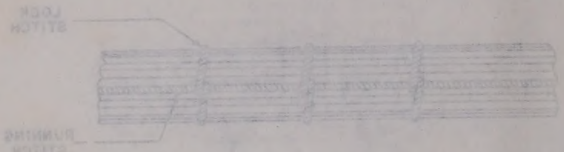
CABLE NO. 3

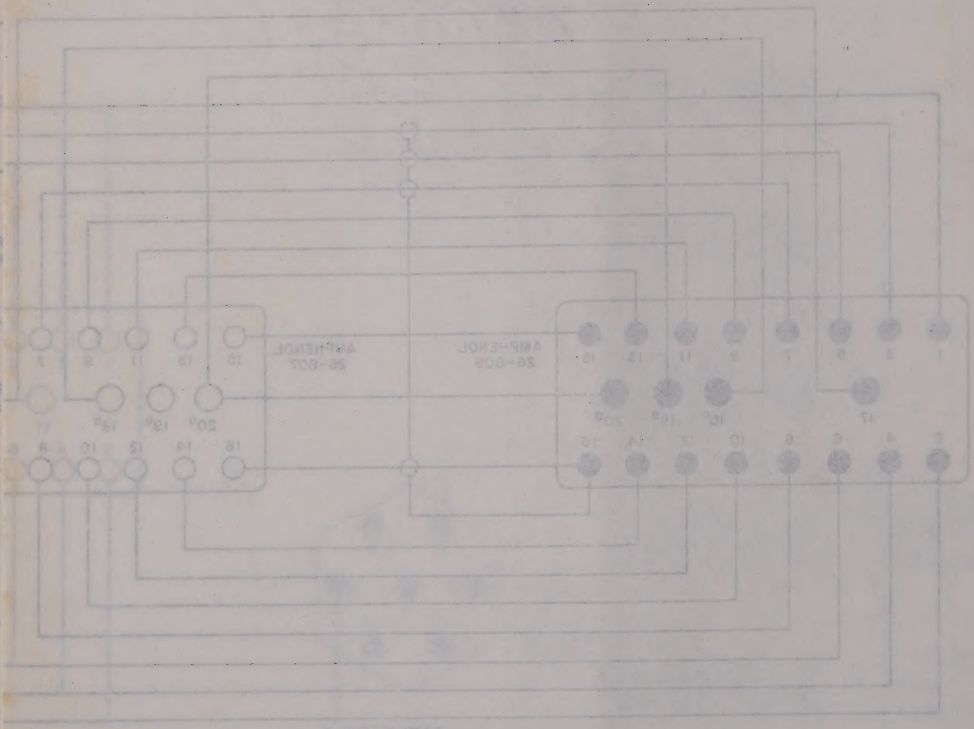


CABLE NO. 4

TM5820-334-35-32

Figure 34. Cable No. 2, 3, and 4, assembly instructions.





CABLE NO 2

45. Checking Plate and Filament Circuits for Shorts

Caution: **In receivers that use an audio module, remove the audio module before checking the plate or filament circuits.**

a. Purpose of Tests. To prevent damage to a receiver brought in for repair, always check the resistance of the plate and filament circuits before applying power to the equipment. Repeated burning out of PLATE 1/2 AMP fuse (F101) is an indication of a short in the plate circuits. Repeated burning out of LINE 5 AMP fuse (F102) is an indication of a short in the filament or associated circuits (relays and oven heater).

b. Conditions of Tests. To prepare for the short circuit tests, perform the following steps:

(1) Remove the receiver from its case (para 60).

(2) Remove the cable from the POWER INPUT-TRANS CONT receptacle.

c. Measurements. Make the resistance measurements indicated in the following chart. A resistance measurement is made from either contact of a fuseholder to ground with a good fuse in place. If abnormal results are obtained, take the corrective measures outlined. When a faulty part is found, repair the trouble before applying power to the receiver.

Action	Point of measurement	Normal indication	Corrective measures
Turn function switch to STAND BY.	PLATE 1/2 AMP fuse (F101)...	Infinity	Check af, vfo, and crystal oscillator plate circuits for shorts.
Turn BFO switch ON.....	PLATE 1/2 AMP fuse (F101)...	Infinity	Check BFO plate circuit for shorts.
Turn function switch to NORMAL.	PLATE 1/2 AMP fuse (F101)...	2,300 ohms	Check the plate circuits not checked in the above procedure.
Turn function switch to STAND BY, BFO switch OFF, DIAL DIM switch OFF.	LINE 5 AMP fuse (F102).....	2.6 ohms	Check all filament circuits, antenna relay K101, break-in relay K602, crystal oven HR 701, and section 1 of switch S104.
Turn DIAL DIM switch ON..	LINE 5 AMP fuse (F102).....	2.6 ohms	Check the dial light circuit.

46. Operational Test

a. Operate the equipment as described in the equipment performance checklist (TM 11-5820-334-20). This checklist is important because it frequently aids in sectionalizing the trouble without the need for further testing. Check for overheated parts, faulty controls, and intermittent operation. Note the CARRIER LEVEL meter indication. A normal meter indication usually indicates satisfactory operation of the agc circuit and all stages up to and including the second if. amplifier.

b. To check the audio and if. stages quickly, connect a headset to one of the AUDIO receptacles on the front panel. Turn the function switch to NORMAL and the AGC switch to ON. Starting at the 8 KC position of the BAND WIDTH switch, set the switch, in turn, to the 4 KC and 2 KC position. If the volume of the rushing sound heard in the headset decreases noticeably with each lower setting of the BAND WIDTH switch, the if. and audio stages are probably operating normally.

c. The calibration-oscillator signal can be used as a convenient means of quickly localizing trouble in the receiver as follows.

(1) To check the synchronization of the rf bandswitch and the crystal switch, connect a headset to one of the AUDIO receptacles on the front panel. Set the function switch at NORMAL and the AGC switch at

CAL. Starting with the lowest detent (extreme counterclockwise) position of the MEGACYCLES control, turn the control clockwise to each detent position in succession. Adjust the BFO PITCH control to obtain a signal in the headset at each detent position. If no audible signal is heard in a detent position, trouble in the contact of the rf bandswitch or the crystal switch is indicated.

(2) The synchronization of the tuning shafts can be quickly checked as follows:

(a) Set the frequency indicator dial so that the first two digits are zeros and the last three digits indicate 500.

(b) Set the function switch at NORMAL and the AGC switch at CAL.

(c) Turn the RF GAIN SQUELCH THRESH control clockwise until an indication is obtained on the CARRIER LEVEL meter.

(d) Remove the receiver from its case (para 60) and raise the 0.5- to 1-mc rf slug rack (fig. 59) slightly by hand; the indication on the CARRIER LEVEL meter should decrease.

(e) Depress the 0.5- to 1-mc rf slug rack slightly by hand; the indication on the meter should decrease. If the meter indication increases when the slug rack is either raised or depressed, the camshaft is out of synchronization or alignment (para 71).

(f) Repeat procedures (*a*) through (*e*) above for each rf slug rack, adjusting the MEGACYCLES control so that the first two digits on the frequency indicator dial indicates a frequency within the band covered by the slug rack being checked.

47. Troubleshooting Chart

The following chart will aid in locating defective components in the radio receiver. This chart lists the symptoms which the repairman observes, either visually or aurally, while making simple tests. The chart also shows how to localize trouble quickly to the defective audio, if., or rf section. The signal-substitution tests outlined in paragraphs 49 through 53 may be used to supplement the tests in this chart. Once the trouble has been localized to a stage, a tube check and voltage and resistance measurements of the stage should isolate the defective part.

Item	Indication	Probable trouble	Procedure
1	When function switch is in NORMAL position, receiver fails to operate and dial lamp does not light. (DIAL DIM switch at ON).	Open LINE 5 AMP fuse (F102) on front panel of receiver.	Replace fuse. If it blows again, check filament circuits for shorts (para 45). Check power connections.
2	Dial lamp lights, but CARRIER LEVEL meter pointer does not deflect (AGC switch set to ON). No reception.	No plate supply voltage. Open PLATE 1/2 AMP fuse (F101) on front panel of receiver.	Replace fuse. If it blows again, test plate circuit for shorts (para 45).
3	No receiver output. CARRIER LEVEL meter pointer rises and dips as KILOCYCLES control is turned.	Defective signal circuits following 2d if. amplifier stage.	Connect headphones with a 0.1-uf capacitor across grid circuits and plate circuits of successive audio stages to localize defective stage. If the audio stages check out, test if. amplifiers following second if. amplifier by signal-substitution (para 51).
4	Some noise in output; no signal reception.	Faulty rf or if. amplifier stage.	Test rf or if. amplifier stages by signal-substitution (para 51 and 52).
5	Hiss in output; no signal reception..	Faulty mixer, oscillator, or rf stages.	Test mixer, rf, and crystal oscillator stages by signal-substitution (para 52).

Item	Indication	Probable trouble	Procedure
6	No beat note during reception when BFO switch is turned to ON and BFO PITCH control is rotated.	Faulty bfo circuit.....	Check BFO switch and BFO PITCH control C101.
7	No calibration beat note when AGC switch is set at CAL. The beat note does not appear at approximately every 100-kc point as the KILOCYCLES control is turned.	Defective calibration-oscillator circuit, or vfo-mixer stage.	Check crystal Y701. Check calibration-oscillator and vfo circuits.
8	Weak signal.....	Weak tubes or low voltage ...	Check input voltage. Check gain of each stage to localize trouble (para 54). If the fault is not located by the above tests, check tuned circuit alignment.
9	Noisy receiver.....	Noisy antenna location. Poor or loose connections of parts or terminals. A noisy tube.	Short circuit antenna to ground. A considerable decrease in noise indicates a noisy signal from the antenna. Use an insulated rod to tap each tube. If tapping a tube causes more noise in the output, replace that tube. Tap the parts. Move terminals slightly and listen for noisy output. Such noise indicates either a poor solder connection or an intermitten part.
10	Receiver output noisy when controls are operated.	Dirty switch contacts. Poor contact at rotor of control.	Clean switch contacts. Clean or replace control.
11	Distorted signal.....	Weak tube. Incorrect voltage on tube. Leaky coupling in audio stage. No agc voltage (receiver blocks with a strong signal).	Check for leaky coupling capacitor. Check agc voltage. If agc voltage is low or zero, check agc circuits.
12	With the function switch at SQ, RF GAIN SQUELCH THRESH control at a low gain setting or at extreme counterclockwise position, noise is heard between received signal points on the dial as the KILOCYCLES control is turned.	Faulty squelch circuit.....	If no click is heard as KILOCYCLES control is rotated, check relay K601 for a mechanical bind or an open winding.
13	Receiver normal on 8- to 32-mc bands but inoperative on 0.5- to 8-mc bands.	Defective 1st mixer or 1st crystal oscillator stage.	Check 1st mixer by voltage and resistance measurements (fig. 78). Check 1st crystal oscillator by voltage and resistance measurements (fig. 78).
14	Receiver inoperative on a band.....	Defective crystal in 1st or 2d crystal oscillator stage.	Check appropriate crystal by substitution (para 53).

48. Voltage and Resistance Measurements

Voltage and resistance diagrams for the various subchassis of the receiver are shown in figures 78, 79, and 80. These diagrams show the voltages and resistances which should be obtained at the tube socket pins. If a reading is different from the reading given in the diagrams (outside of reasonable tolerance limits), the amount of variance should be noted and used to aid in determining which part is at fault. For example, if 100,000-ohm resistance is indicated at a given tube socket pin on a diagram, and the actual indication on the meter is 30,000 ohms, the circuit diagram of the subchassis should be examined for the presence of a component in the circuit under test which could, if defective, account for the incorrect reading (such as a shorted bypass capacitor in the circuit under test). To troubleshoot a defective audio module, check each circuit component with an ohmmeter and compare the

measurement with the value given in figure 20. If a measurement is too low, reverse the meter leads and measure again. Transistors may be checked by substitution. Be careful when soldering transistor leads (para 58).

Caution: **Use a TS-352/U on the R x 1000 range for resistance measurements. A lower range may damage the transistors.**

49. Signal-Substitution

a. Signal-substitution in Radio Receiver R-392/URR requires Audio Oscillator TS-382/U for checking the audio circuits and RF Signal Generator AN/URM-25 for checking rf and if. circuits. After locating a defective stage, use the voltage and resistance diagrams (fig. 78, 79, and 80) to locate the defective component.

b. For the tests described in paragraphs 50 through 52, connect the ground lead of the TS-382/U or AN/URM-25 to the subchassis being tested, and connect the signal output lead, through a 0.05-uf capacitor to the point specified. Use the bench testing information (para 41) and take proper precautions (para 42) when preparing the subchassis for signal tracing. To avoid removing a subchassis to inject a signal at a tube socket pin (where no test jack is supplied), remove the tube; wind one turn of a short, thin, insulated wire (both ends bared) around the desired pin, and replace the tube. Connection for signal injection can then be made to the bare end of the wire. In the following procedures, maintain the same signal generator level for each test connection.

c. Note the volume and listen for distortion from the speaker or headset at various steps in the signal-substitution procedure. Work back from the output to the input stages. If possible, compare results with a receiver known to be in good condition.

d. A tuning shaft which is out of synchronization or a trimmer adjustment that is misaligned may cause reduced output or no output. Synchronization of the shafts and cams and the position of the rf bandswitch and the crystal switch should be checked (para 71 through 74) before the adjustment of individual tuning circuits (para 83 through 90) is attempted.

e. When trouble is localized to a given stage, first test the tube, then measure the terminal voltages, and finally, measure the resistance of the stage circuits.

f. Trouble in a stage does not always change the voltage and resistance measurements at the tube socket. Instructions included in this paragraph merely serve as a guide, and should suggest other procedures, such as resistance measurements of individual parts.

g. In each step, it is assumed that all previous steps were completed satisfactorily. Isolate and clear any trouble discovered before proceeding with the next step.

50. Audio Subchassis Tests (fig. 35-38)

Step	Test connection	Normal indication	Corrective measures
1	Apply a 1,000-cycle audio signal first to pin 4 and then to pin 8 of V608. *Note.* Steps 2 and 3 do not apply to receivers using an audio module.	Low-volume tone in headset..	Check headset. Check seating of P113. Check T603. Check C628 for short.
2	Apply the 1,000-cycle audio signal first to pin 1 and then to pin 3 of V608.	Increase in audio volume. Volume is the same for both pin test connections.	Check C626 and C627 for leakage. Check R631 and R632.
3	Apply the 1,000-cycle audio signal first to pin 5 and then to pin 7 of V607. *Note.* Steps 4 and 5 apply only to receivers using an audio module.	Audio volume the same as in step 2. Volume is the same for both pin test connections.	Check C626 and C627.

Step	Test connection	Normal indication	Corrective measures
4	Apply a 1,000-cycle audio signal first to pin 4 and then to pin 8 of the audio module.	Low-volume tone in headset..	Check headset. Check seating of P113. Check T603. Check C628 for short.
5	Apply a 1,000-cycle audio signal to pin 7 of V607.	Increase in audio volume	Check C627.
6	Apply the 1,000-cycle audio signal to pin 1 of V607.	Audio volume slightly less than in step 3 (V608 output) or step 5 (audio module output).	Check R627, R628, and R630. Check C623.
7	Apply the 1,000-cycle audio signal to pin 5 of V606.	Same audio volume as in step 6.	Check C623 for open.
8	Turn RF GAIN SQUELCH THRESH control R105 fully counterclockwise and turn AF GAIN control R103 fully clockwise.		
	Apply the 1,000-cycle audio signal to pin 1 of V606.	Increase in audio volume	Check R623, R625, and R626. Check C622 and C637. Check AF GAIN control R103.
9	Apply the 1,000-cycle audio signal to J615.	Same audio volume as in step 8.	Check V603 circuit components.

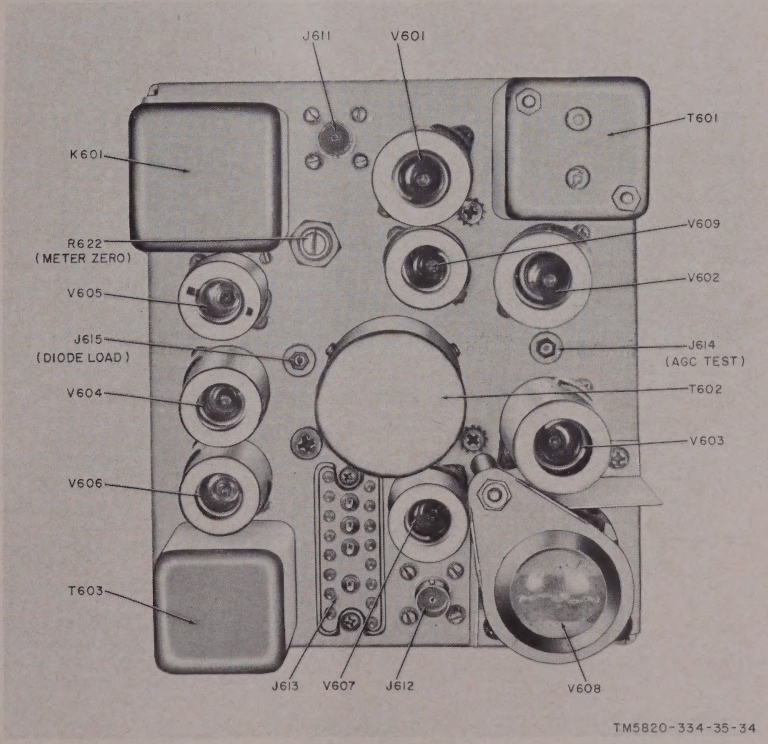


Figure 35. Audio subchassis, top view.

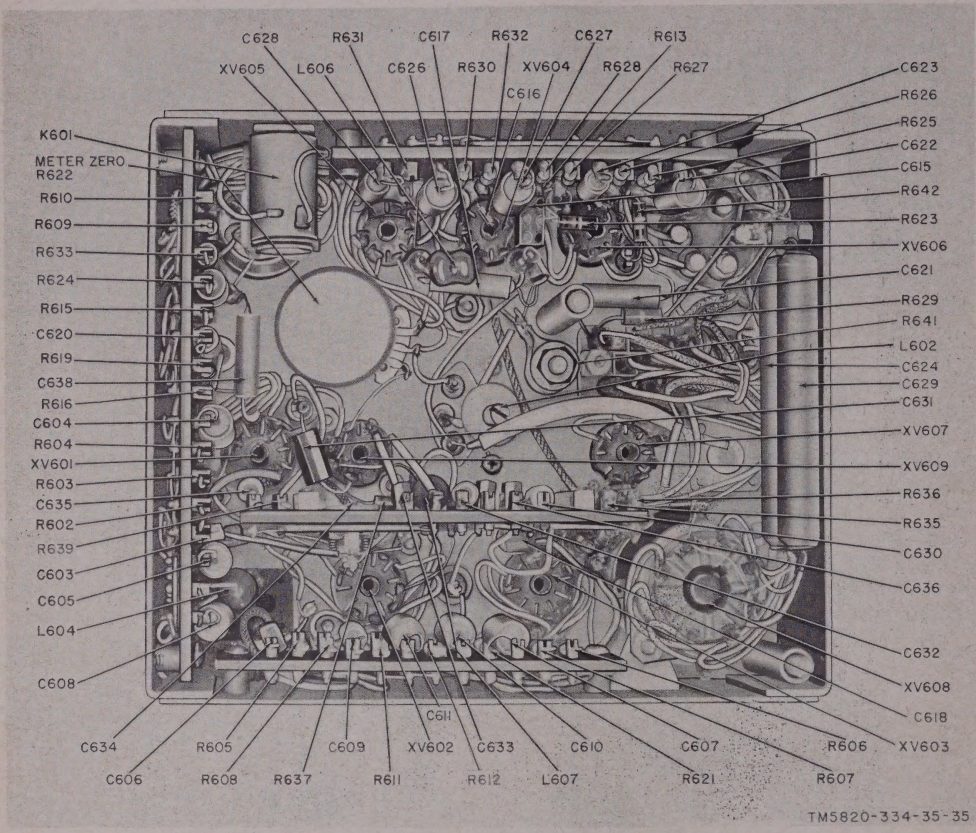


Figure 36. Audio subchassis, bottom view.

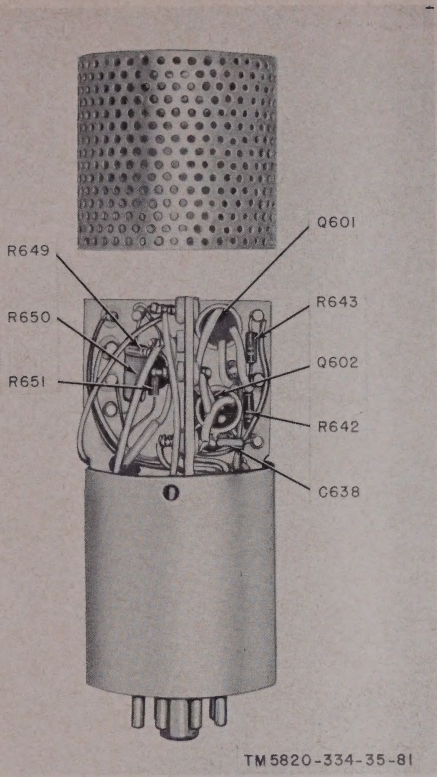


Figure 37. Audio module, left side view, cover removed.

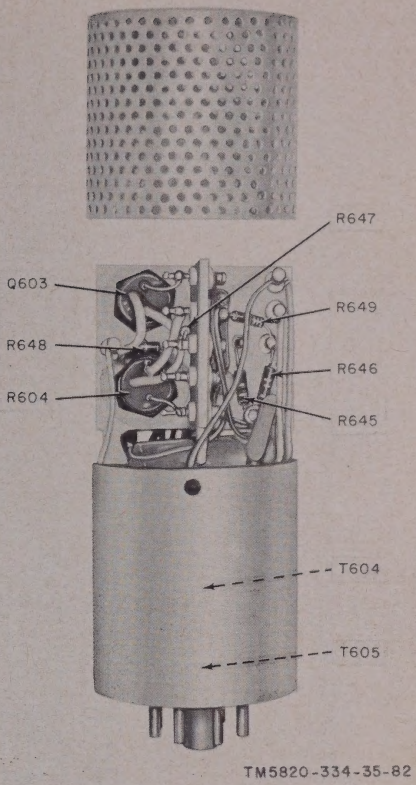


Figure 38. Audio module, right side view, cover removed.

51. If. Subchassis Tests
(fig. 39 and 40)

Step	Test connection	Normal indication	Corrective measures
1	Apply a modulated 455-kc signal to pin 5 of V506.	Audio heard in headset	Check T601 for open or shorted winding. Check C602.
2	Apply the modulated 455-kc signal to pin 1 of V506.	Increase in audio volume ...	Check C529 for open.
3	Make the following settings on the receiver: Function switch to NORMAL. AGC switch to OFF. RF GAIN SQUELCH THRESH control fully clockwise. BAND WIDTH switch to 4 KC. Apply the modulated 455-kc signal first to pin 5 and then to pin 1 of V505, V504, V503, V502, and V501, in that order.	Audio volume should be approximately the same for all test connections.	Check the components of any stage that does not provide a normal indication.

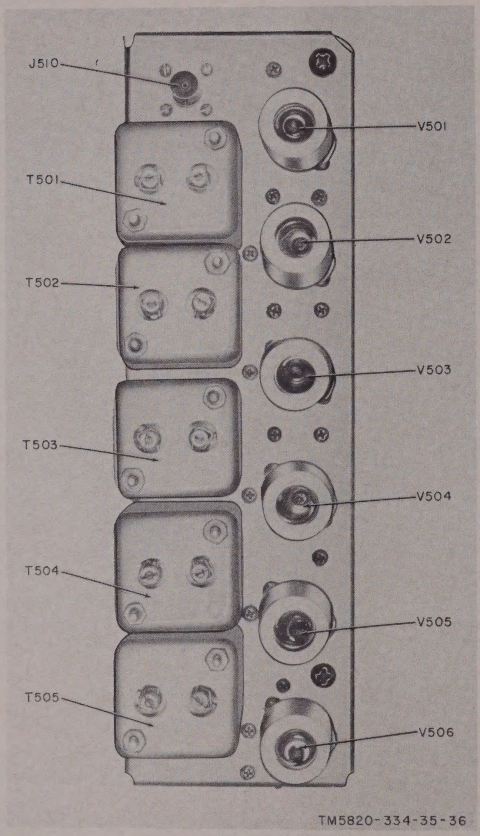


Figure 39. If. subchassis, top view.

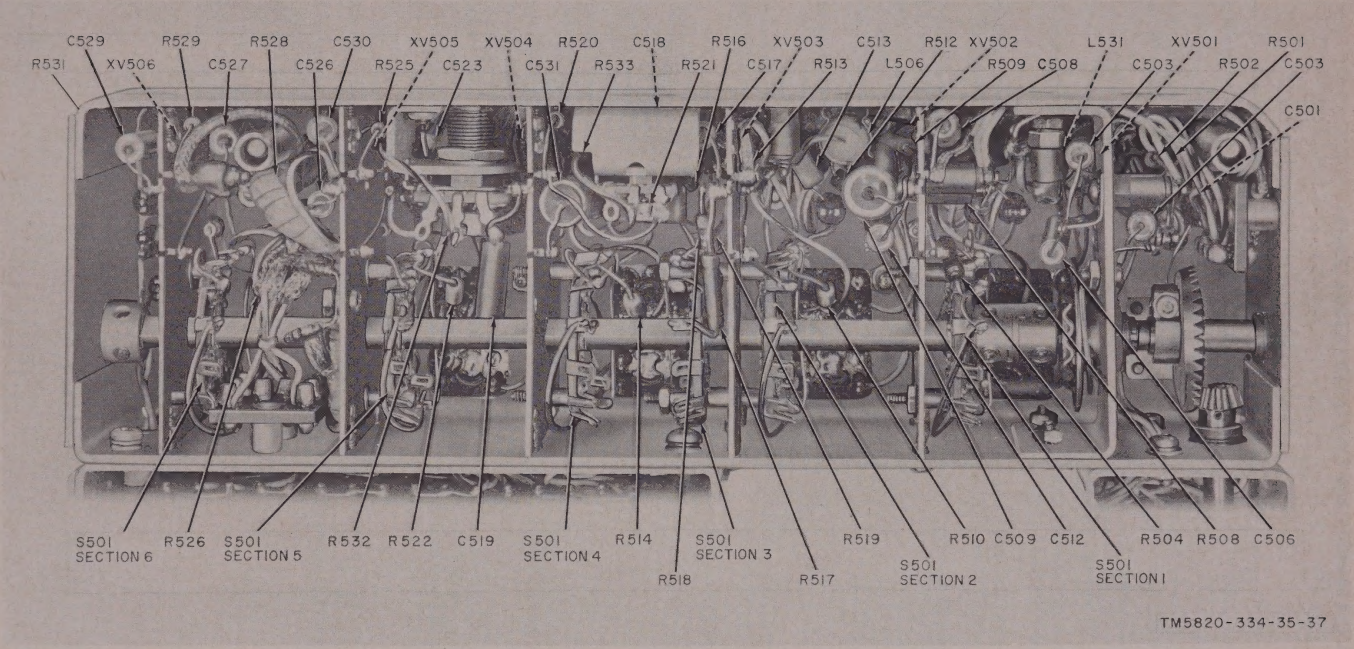


Figure 40. If. subchassis, bottom view.

52. Vfo, Upper Deck Assembly and Crystal Oscillator Tests (fig. 41-45 and 57)

Step	Test connection	Normal indication	Corrective measures
1	Apply a modulated 455-kc signal to pin 5 of V801 (fig. 41 and 42). *Note.* For the remaining steps, tune the receiver to 2 mc in the 1- to 2-mc band (indicator reading of 01+000 (note plus sign)).	Audio heard in headset	Check seating of P810. Check T801 for open or shorted winding. Check C501.
2	Disconnect P208 from J808 and apply a 2-mc modulated signal to J808 (fig. 41).	Audio heard in headset	Check alignment of Z801 (para 75).
3	Reconnect P208 to J808. Apply a 2-mc modulated signal to pin 7 of V204 (fig. 43).	Audio heard in headset	Check synchronization of Z222, Z223 and Z224 (para 73 and 87).
4	Apply a 10-mc modulated signal to E204 (fig. 43).	Audio heard in headset	Disconnect P403 from J203 (fig. 45 and 57) and check for 2 to 3 volts of rf voltage at P403. If the rf voltage is normal, check alignment of Z222, Z223, and Z224 (para 87). If the rf voltage is abnormal, check alignment of oscillator circuits (para 85).
5	Apply a 10-mc modulated signal to pin 7 of V203 (fig. 43 and 44).	Audio heard in headset	Check synchronization of first variable if. slug rack and can rack (para 73).
6	Apply a 2-mc modulated signal to E203 (fig. 43).	Audio heard in headset	Disconnect P402 from J202 (fig. 45 and 57) and check for 2 to 3 volts of rf voltage at P402. If the rf voltage is normal, check alignment of Z219, Z220, and Z221 (para 88). If the rf voltage is abnormal, check alignment of T401 (para 86).
7	Apply a 2-mc modulated signal to pin 5 of V202 (fig. 43 and 44).	Audio heard in headset	Check Z214. Check sections 6 and 7 of S201. Check synchronization of slug rack for Z214 (para 73).
8	Apply a 2-mc modulated signal to pin 1 of V202 (fig. 43 and 44).	Increase in audio volume ...	Check V202 circuit components.
9	Apply a 2-mc modulated signal to pin 5 of V201 (fig. 43 and 44).	Same audio volume as in step 8.	Check Z208. Check sections 4 and 5 of S201. Check synchronization of slug rack for Z208 (para 73).
10	Apply a 2-mc modulated signal to pin 1 of V201 (fig. 43 and 44).	Increase in audio volume ...	Check V201 circuit components.
11	Apply a 2-mc modulated signal to ANT post E101.	Same audio volume as in step 10.	Check seating of P206 (fig. 43). Check relay K101 (fig. 43). Check sections 1 and 2 of S201 (fig. 44). Check Z202 (fig. 43 and 44). Check synchronization of slug rack for Z202 (para 73).

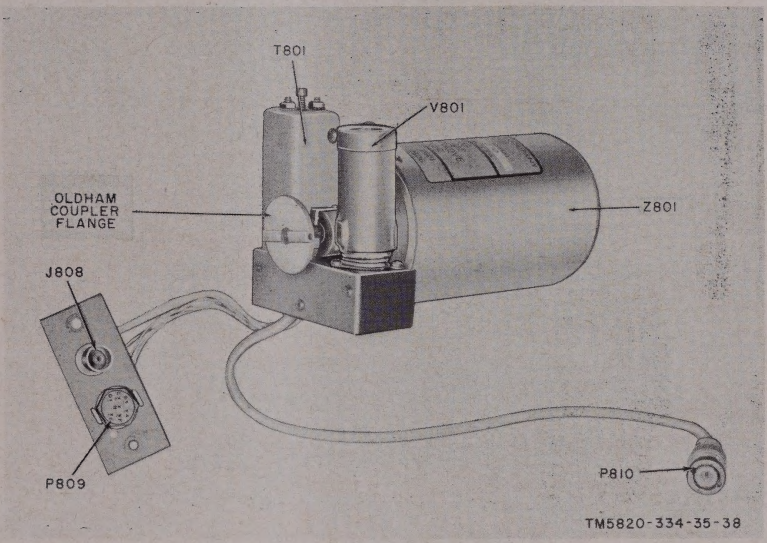


Figure 41. Vfo subchassis.

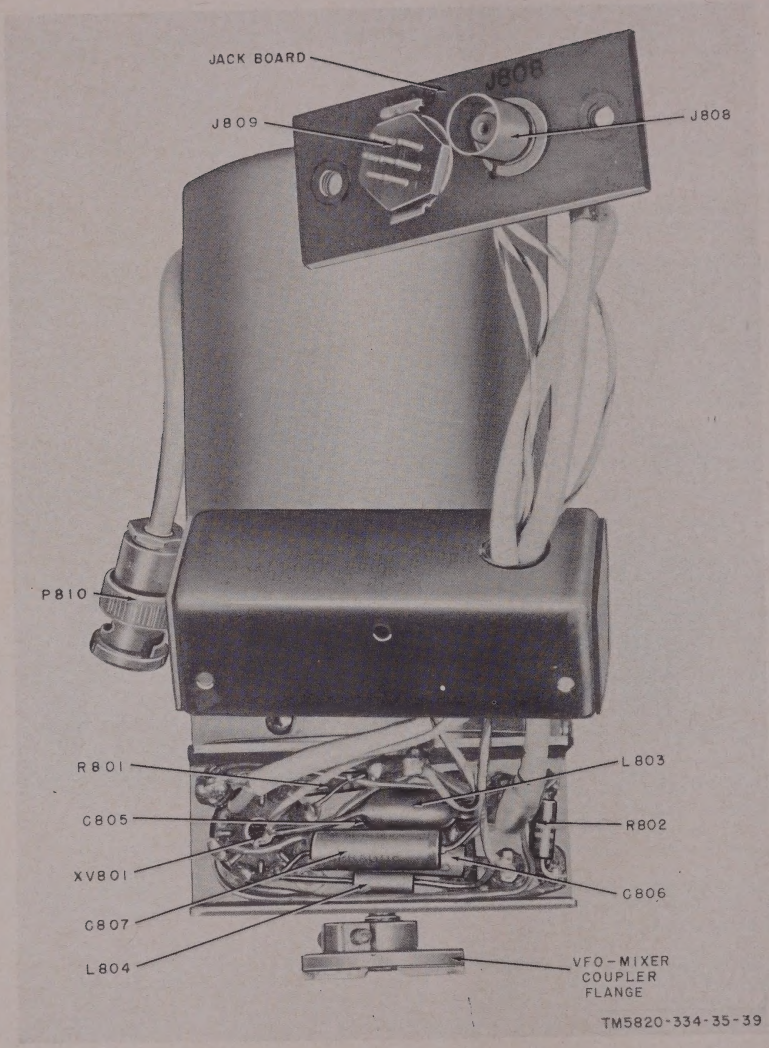


Figure 42. Vfo subchassis, bottom cover removed.

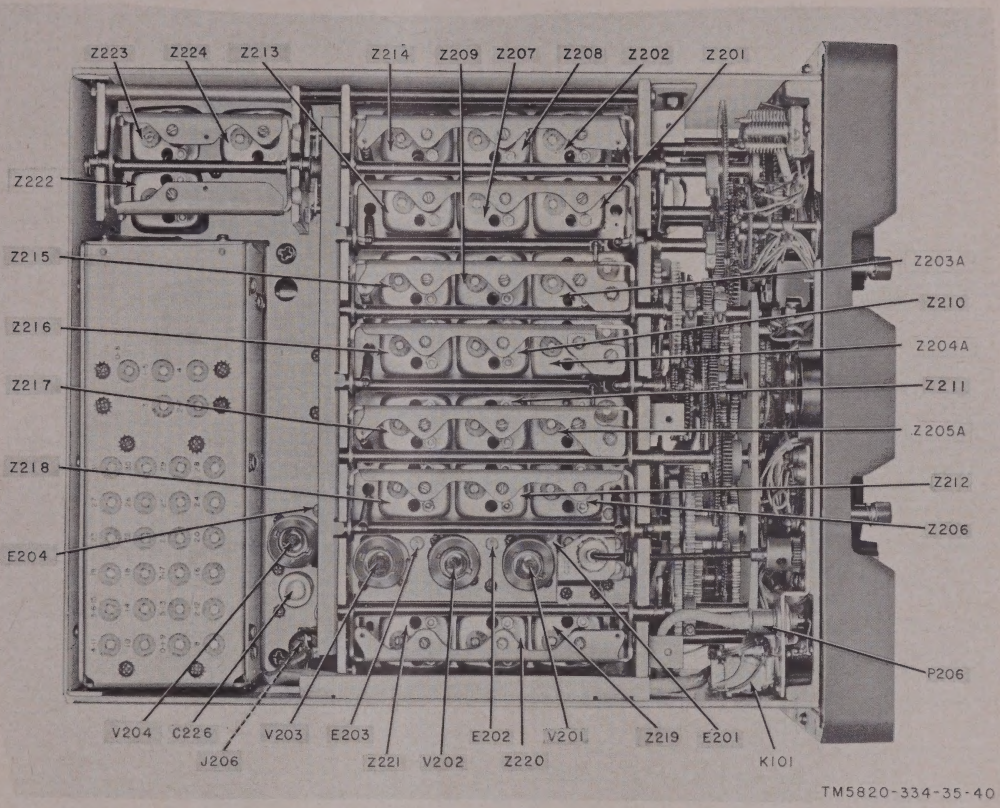


Figure 43. Upper deck assembly, top view.

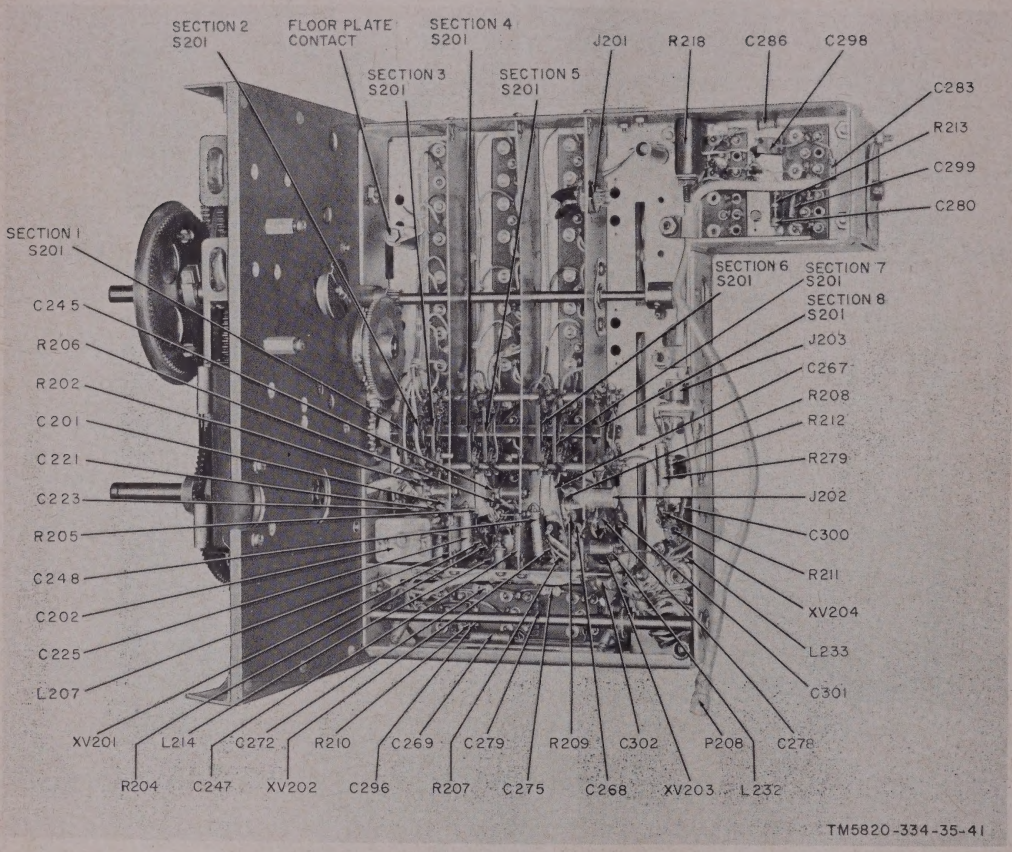


Figure 44. Upper deck assembly, bottom view.

53. Checking Oscillator Crystals (fig. 46, 48, and 49)

If an oscillator crystal is suspect, it can be readily checked by substituting a crystal of the same type known to be good.

a. First Crystal Oscillator Crystal Location. The following chart lists the crystal symbol, the fundamental frequency, and the bands in which each crystal in the first crystal oscillator is used. Refer to figure 49 for crystal location.

Crystal symbol	Fundamental frequency (mc)	Bands (mc)
Y401	9	0.5-1 6-7
Y402	8	1-2 5-6
Y403	10	2-3 7-8
Y404	12.6	3-4
Y405	7	4-5

b. Second Crystal Oscillator Crystal Location. The following chart lists the crystal symbol, the fundamental frequency, and the bands in which each crystal in the second crystal oscillator is used. Refer to figures 46 and 48 for crystal location.

Crystal symbol	Fundamental frequency (mc)	Bands (mc)
Y406	12	0.5-1 1-2 9-10 21-22
Y407	15	2-3 12-13
Y408	6.2	3-4
Y409	14	4-5 11-12 25-26
Y410	8	5-6 13-14
Y411	9	6-7 15-16 24-25
Y412	10	7-8 17-18 27-28
Y413	11	8-9 19-20 30-31
Y414	13	10-11 23-24
Y415	8.5	14-15
Y416	11.333	31-32
Y417	10.667	29-30
Y418	10.333	28-29
Y419	9.667	26-27
Y420	12.5	22-23
Y421	11.5	20-21
Y422	10.5	18-19
Y423	9.5	16-17

54. Stage-Gain Charts

The stage-gain charts list the minimum and maximum voltages required at each of the rf and if. stages of the receiver to produce 2.5 negative dc volts across the diode-load resistor. Use these charts as a standard when troubleshooting to check the overall gain of the receiver and the gain of each rf or if. stage or group of stages. When the receiver output is low and the tubes test normal, localize the defective stage by checking the signal voltage level of each stage against the chart during troubleshooting, by signal-substitution, or by measuring the individual stage gain. Obtain the stage-gain readings using Multimeter, Meter ME-26/U connected between jack J615 (fig. 35) and ground (diode load). Connect the ground lead of RF Signal Generator AN/URM-25 to the receiver ground, and connect the generator output lead through a 0.05-microfared (uf) capacitor to the receiver points indicated in the chart. Use a 50-micromicrofared (uuf) capacitor to connect to the ANT binding post (E101) on the front panel. When checking the 455-kc if. stages, gain access to the injection points by winding 1 turn of a short length of wire around the desired pin of the tube in the stage being tested. Check the output from the AN/URM-25 required to obtain the diode-load reference voltage of 2.5 volts against the figures given in the charts. The lowest figure is the minimum, and the highest is the maximum

that should be required over the specified frequency range for normal operation. However, a reading that is slightly outside this range does not necessarily indicate a receiver malfunction.

a. Rf Subchassis Stages (fig. 43 and 53).

Signal generator output connection	Frequency (mc)	Signal generator output (uv)
ANT binding post E101	0.5 to 32	1 to 4
Test point E201 (control grid of first rf amplifier V201)	0.5 to 32	3 to 7
Test point E202 (control grid of second rf amplifier V202)	0.5 to 32	3 to 7
Test point E203 (grid of first mixer V203)	0.5 to 0.8	25 to 45
Test point E204 (grid of second mixer V204)	8 to 32	20 to 35
Connector J808 (grid (pin 7) of vfo-mixer V801)	3 to 2	40 to 70

b. If. Subchassis Stages (fig. 39).

Signal generator output connection	Signal generator output (uv)		
	2 KC BAND WIDTH	4 KC BAND WIDTH	8 KC BAND WIDTH
Control grid (pin 1) of first if. amplifier V501	130 to 180		
Control grid (pin 1) of second if. amplifier V502	3,300 to 6,000	3,200 to 5,900	2,900 to 5,700
Control grid (pin 1) of third if. amplifier V503	24,000 to 41,000	28,000 to 45,000	22,000 to 38,000
Control grid (pin 1) of fourth if. amplifier V504	25,000 to 40,000	25,000 to 40,000	23,000 to 37,000
Control grid (pin 1) of fifth if. amplifier V505	22,000 to 34,000	22,000 to 32,000	25,000 to 35,000
Control grid (pin 1) of sixth if. amplifier V506	50,000 to 70,000	50,000 to 70,000	50,000 to 70,000

55. Troubleshooting Calibration Oscillator (fig. 50, 51, and 52)

Note. Waveform measurements are performed at fourth and fifth echelons.

If no calibration signal is heard, remove the lower deck assembly for troubleshooting (para 62) and make voltage and resistance measurements in the calibration oscillator (fig. 79). If the reason for failure is not detected by the above checks, troubleshoot with Oscilloscope AN/USM-50.

a. Connect the AN/USM-50 to pin 1 of 200-kc crystal oscillator V702. A waveform similar to the waveform shown in A, figure 52, should be observed. If the waveform is distorted, check crystal Y701, grid resistor R706, capacitors C708, C709, and C706, and screen-grid resistor R707.

Note. Components should be checked by substitution of parts which are known to be good.

b. Connect the AN/USM-50 to pin 5 of V702. A waveform similar to the waveform shown in B, figure 52, should be observed. If the waveform is distorted, check plate resistor R708 and capacitors C711, C703, and C704.

c. Check the waveforms at multivibrator V701 by connecting the AN/USM-50 to the pins indicated in C through F, figure 52. If there is any distortion in the waveforms observed on the AN/USM-50 as compared with those shown in the figure, check all the components in the V701 circuits.

d. Check the waveforms at harmonic amplifier V703A and distorter V703B by connecting the AN/USM-50 to the pins indicated in G through L, figure 52. If there is any distortion in the waveforms observed on the AN/USM-50 as compared with those shown in the figure, check all the components in the V703A and V703B circuits.

56. Dc Resistances of Transformers and Coils

The dc resistances of the transformer windings and the coils in Radio Receiver R-392/URR are listed in *a* and *b* below.

a. Rf and Crystal Oscillator Subchassis (fig. 43, 44, and 45).

Transformer or coil	Terminals	Ohms
Z201	1-3, 4	2.5
Z207	1-3	2.5
Z213	1-3	2.5
Z202	1-3, 4	3.0
Z208	1-3	1.9
Z214	1-3	1.9
Z203A	1-3	0.2
	1-4	1.6
Z209	1-3	1.15
Z215	1-3	1.15
Z204A	1-3	0.3
	1-4	0.6
Z210	1-3	0.33
Z216	1-3	0.33
Z205A	1-3	0.1
	1-4	0.2
Z211	1-3	0.15
Z217	1-3	0.15
Z206	1,4-3	0.1
Z212	1-3	Less than 0.1
Z218	1-3	Less than 0.1
Z219	1-3	0.16
Z220	1-3	0.16
Z221	1-3	0.16
Z222	1-3	1.7
Z223	1-3	1.7
Z224	1-3	1.7
T401	1-2	Less than 0.1
	3-4	Less than 0.1
T402	1-2	Less than 0.1
	3-4	Less than 0.1

b. Lower Deck Assembly (fig. 36 and 40).

Transformer or coil	Terminals	Ohms
T501	2-9	0.9
	3-10	0.6
T502	2-9	1.2
T503	2-9	1.2
T504	3-10	0.6
T505	3-10	0.6
T601	1-9	1.4
	4-6	1.5
T603	2-3	100
	1-3	100
	4-5	88

57. Rf and Variable If. Conversion Scheme (fig. 81)

The charts in *a* and *b* below are provided so that the frequency conversion scheme of Radio Receiver R-392/URR may be easily understood. The chart in *a* shows the band to which the receiver is tuned, the position of rf bandswitch S201 and the contacts of the switch which are closed for each position (there are six positions), the frequency range of the antenna and rf coil in use, and the contact of 32-position crystal oscillator switch S401. The chart in *b* shows the crystal frequency and the output frequency of the first crystal oscillator, the frequency range of the first variable intermediate frequency, the crystal frequency and the output frequency of the second crystal oscillator, the frequency range of the second variable intermediate frequency and the vfo-mixer, and the resultant intermediate frequency of 455 kc. The following is an example of the use of the charts: The frequency indicator dial reading is 05 500 (5.5 mc). The band in use is from 5 to 6 mc (column 1, *a* below). The rotating segment of rf bandswitch S201 connects contact 8 to 5 (column 2, *a* below) into the circuit, which selects the 4- to 8-mc antenna and rf coils (column 3, *a* below). The rotating arm of crystal oscillator switch S401 connects contact 5 (column 4, *a* below) in the circuit, which connects the crystal to be used in the first crystal oscillator (column 2, *b* below). This frequency is 8 mc. The output frequency of the first crystal oscillator is 8 mc (column 3, *b* below), which is heterodyned with 5.5 mc in the first mixer (V203) to produce the first variable intermediate frequency of 13.5 mc (column 4, *b* below). The crystal frequency of the second crystal oscillator is 8 mc (column 5, *b* below), and its output frequency is 16 mc (column 6, *b* below). The 16-mc output of the second crystal oscillator is heterodyned with the 13.5-mc signal of the first variable intermediate frequency to produce a 2.5-mc second variable intermediate frequency in the second mixer (V204) (column 7, *b* below). The 2.5-mc output frequency of the second

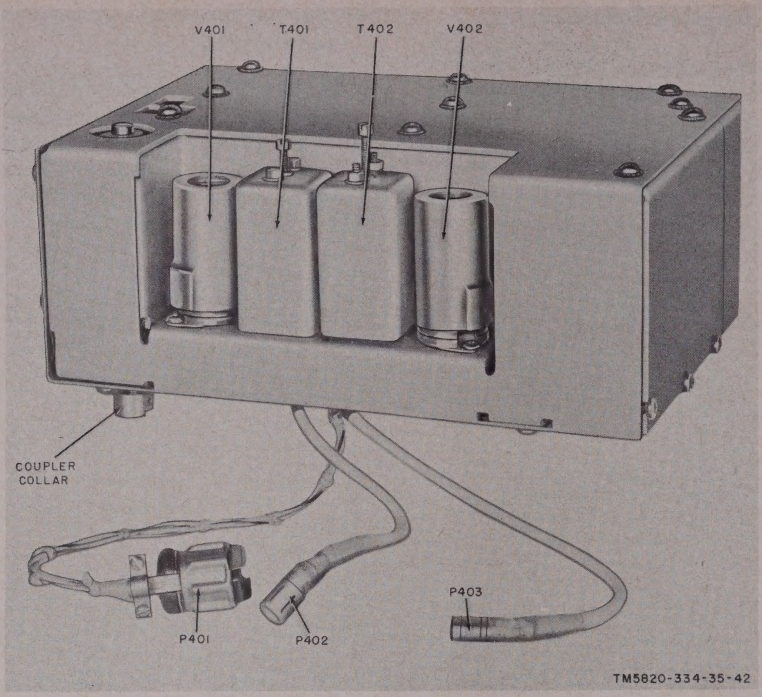


Figure 45. Crystal oscillator subchassis, bottom view.

variable intermediate frequency is heterodyned with the 2.955-mc signal of the oscillator portion of vfo-mixer V801 (column 8, *b* below), to produce a fixed intermediate frequency of 455 kc at the output of the vfo-mixer (column 9, *b* below). The example showing use of the charts is given below:

Frequency of station being received	5.500 mc.
Indicator dial reading	05 500.
MEGACYCLES dial setting	05.
KILOCYCLES dial setting	500.
Band	5-6.
1st crystal oscillator frequency	8 mc.
1st crystal oscillator output frequency	8 mc.
1st variable if.	13.5 mc. (See note 1.)
2d crystal oscillator frequency	8 mc.
2d crystal oscillator output frequency	16 mc.
2d variable if.	2.5 mc. (See note 2.)
Vfo-mixer frequency (oscillator portion)	9.955-mc. (See note 3.)
Fixed intermediate frequency (output of vfo-mixer)	455 kc.

Notes:

1. The first variable if. equals the first crystal oscillator output plus the frequency of the station or signal received.

2. The second variable if. equals the difference frequency between the second crystal oscillator output frequency and the first variable if.

3. The vfo-mixer frequency equals the second variable if. plus the fixed intermediate frequency.

a. Antenna and If. Amplifier Circuit Selection.

1	2		3	4
Band (mc)	Rf bandswitch S201 (fig. 81)		Range of antenna and rf coils (mc)	Contact of switch S401 (fig. 81)
	Position	Circuit closed between contacts:		
0.5-1	1	8 and 1	0.5-1	0
1-2	2	8 and 2	1-2	1
2-3	3	8 and 3	2-4	2
3-4	3	8 and 3	2-4	3
4-5	4	8 and 5	4-8	4
5-6	4	8 and 5	4-8	5
6-7	4	8 and 5	4-8	6
7-8	4	8 and 5	4-8	7
8-9	5	8 and 6	8-16	8
9-10	5	8 and 6	8-16	9
10-11	5	8 and 6	8-16	10
11-12	5	8 and 6	8-16	11
12-13	5	8 and 6	8-16	12
13-14	5	8 and 6	8-16	13
14-15	5	8 and 6	8-16	14
15-16	5	8 and 6	8-16	15
16-17	6	8 and 7	16-32	16
17-18	6	8 and 7	16-32	17
18-19	6	8 and 7	16-32	18
19-20	6	8 and 7	16-32	19
20-21	6	8 and 7	16-32	20
21-22	6	8 and 7	16-32	21
22-23	6	8 and 7	16-32	22
23-24	6	8 and 7	16-32	23
24-25	6	8 and 7	16-32	24
25-26	6	8 and 7	16-32	25
26-27	6	8 and 7	16-32	26
27-28	6	8 and 7	16-32	27
28-29	6	8 and 7	16-32	28
29-30	6	8 and 7	16-32	29
30-31	6	8 and 7	16-32	30
31-32	6	8 and 7	16-32	31

b. Oscillator and If. Circuit Selection.

1	2	3	4	5	6	7	8	9
Band (mc)	1st xtal osc crystal freq (mc)	1st xtal osc output freq (mc)	1st variable if. range (mc)	2nd xtal osc crystal freq (mc)	2d xtal osc output freq (mc)	2d variable if. range (mc)	Vfo-mixer range (mc)	Fixed intermediate frequency (kc)
0.5-1	9	9	9.5-10	12	12	2.5-2[a]	2.955-2.455[a]	455
1-2	8	8	9-10	12	12	3-2	3.455-2.455	455
2-3	10	10	12-13	15	15	3-2	3.455-2.455	455
3-4	12.6	12.6	15.6-16.6	6.2	18	3-2	3.455-2.455	455
4-5	7	7	11-12	14	14	3-2	3.455-2.455	455
5-6	8	8	13-14	8	16	3-2	3.455-2.455	455
6-7	9	9	15-16	9	18	3-2	3.455-2.455	455
7-8	10	10	17-18	10	20	3-2	3.455-2.455	455
8-9	Not in use after first eight frequency bands.			11	11	3-2	3.455-2.455	455
9-10				12	12	3-2	3.455-2.455	455
10-11				13	13	3-2	3.455-2.455	455
11-12				14	14	2-3	3.455-2.455	455
12-13				15	15	3-2	3.455-2.455	455
13-14				8	16	3-2	3.455-2.455	455
14-15				8.5	17	3-2	3.455-2.455	455
15-16				9	18	3-2	3.455-2.455	455
16-17				9.5	19	3-2	3.455-2.455	455
17-18				10	20	3-2	3.455-2.455	455
18-19				10.5	21	3-2	3.455-2.455	455
19-20				11	22	3-2	3.455-2.455	455
20-21				11.5	23	3-2	3.455-2.455	455
21-22				12	24	3-2	3.455-2.455	455
22-23				12.5	25	3-2	3.455-2.455	455
23-24				13	26	3-2	3.455-2.455	455
24-25				9	27	3-2	3.455-2.455	455
25-26				14	28	3-2	3.455-2.455	455
26-27				9.666	29	3-2	3.455-2.455	455
27-28				10	30	3-2	3.455-2.455	455
28-29				10.333	31	3-2	3.455-2.455	455
29-30				10.666	32	3-2	3.455-2.455	455
30-31				11	33	3-2	3.455-2.455	455
31-32				11.333	34	3-2	3.455-2.455	455

[a] The range of the second variable if. is from 2.5 to 2.0 mc for the 0.5- to 1-mc band, and from 3.0 to 2.0 for all other bands.

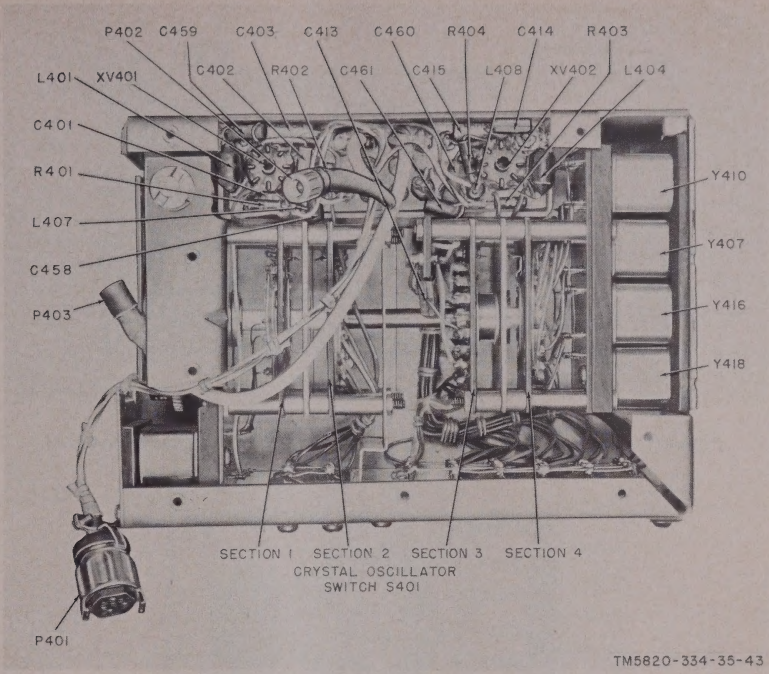


Figure 46. Crystal oscillator subchassis, front view, cover removed.

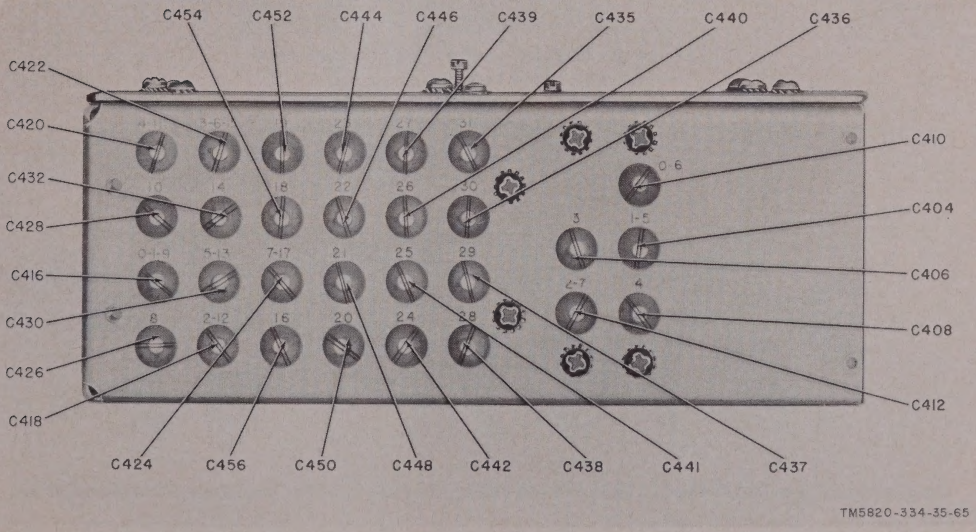


Figure 47. Crystal oscillator subchassis, top view.

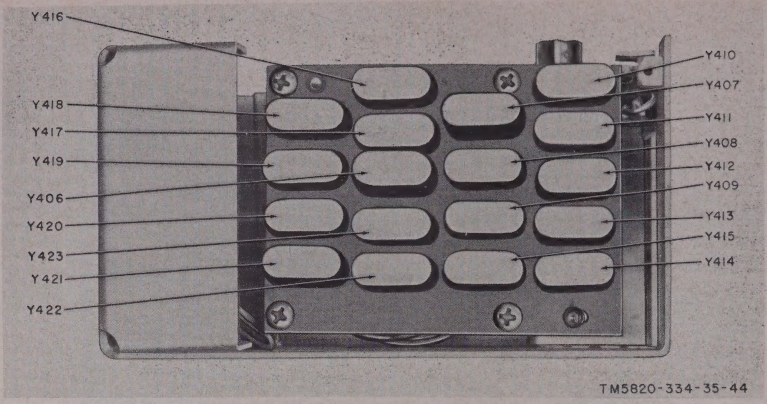


Figure 48. Crystal oscillator subchassis, left side view, cover removed.

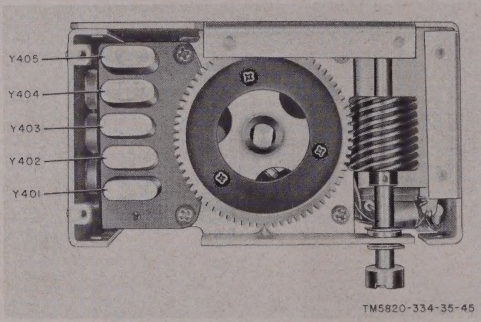


Figure 49. Crystal oscillator subchassis, right side view, cover removed.

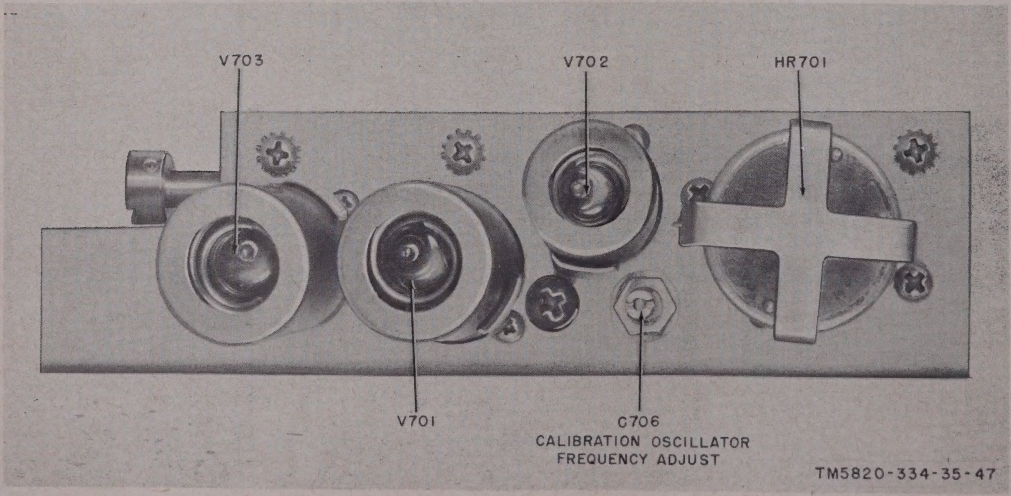


Figure 50. Calibration oscillator subchassis, top view.

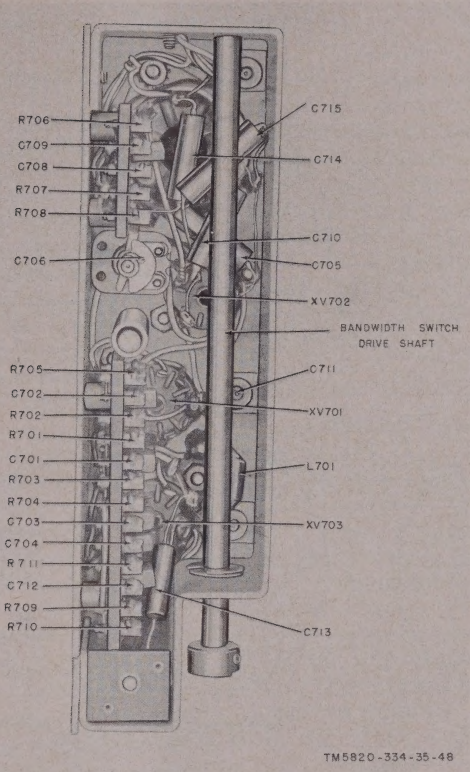
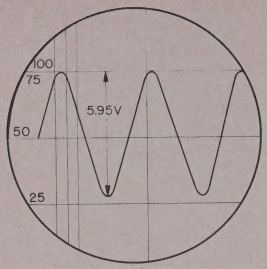
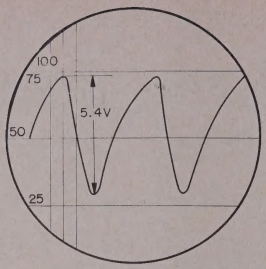


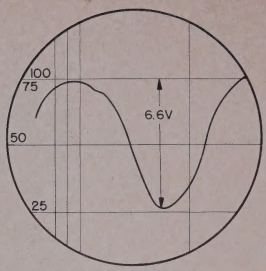
Figure 51. Calibration oscillator subchassis, bottom view.



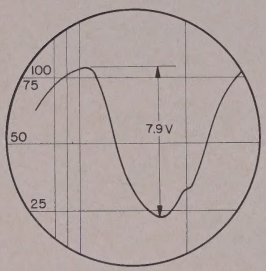
(A)
WAVEFORM AT GRID
PIN 1, V702



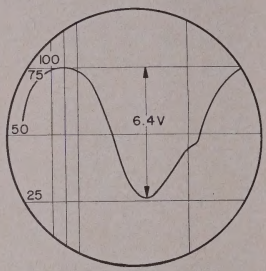
(B)
WAVEFORM AT PLATE
PIN 5, V702



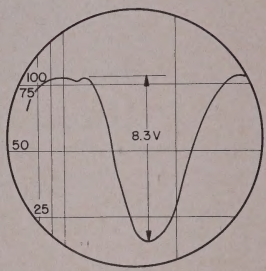
(C)
WAVEFORM AT GRID
PIN 2, V701



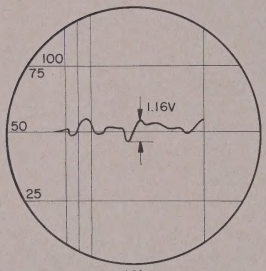
(D)
WAVEFORM AT PLATE
PIN 1, V701



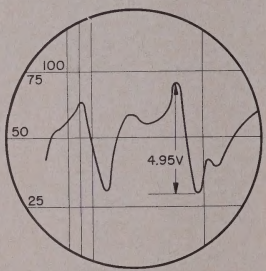
(E)
WAVEFORM AT GRID
PIN 7, V701



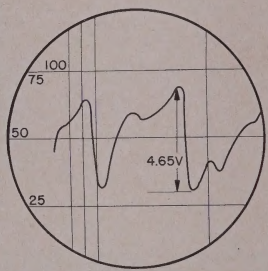
(F)
WAVEFORM AT PLATE
PIN 6, V701



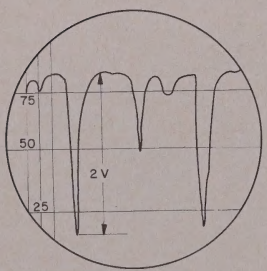
(G)
WAVEFORM AT GRID
PIN 2, V703



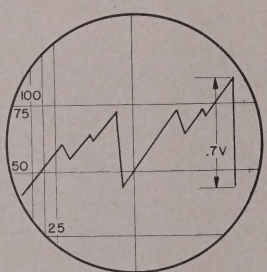
(H)
WAVEFORM AT PLATE
PIN 1, V703



(J)
WAVEFORM AT GRID
PIN 7, V703



(K)
WAVEFORM AT PLATE
PIN 6, V703
WITHOUT L702



(L)
WAVEFORM AT PLATE
PIN 6, V703

TM5820-334-35-83

Figure 52. Waveforms in calibration oscillator subchassis.

CHAPTER 3
REPAIRS AND ALIGNMENT

Note. All repairs and alignment may be performed by third echelon maintenance personnel unless otherwise noted.

Section I. REPAIRS

58. General Parts Replacement Techniques

Most of the parts in the receiver can be reached and replaced without special procedures. The following precautions apply specifically to this receiver.

a. When a ceramic-type capacitor is soldered, be careful not to overheat the capacitor. Use a pencil-type soldering iron with a 25-watt maximum capacity.

b. When soldering in the transistorized audio module, use a pencil-type soldering iron with a 25-watt maximum capacity. Before using a soldering iron, check for a short between the element and the tip. *Do not use if shorted.* Use an isolating transformer when only an ac operated iron is available. When soldering a transistor, grasp the lead between the transistor and the solder connection with a pair of long-nosed pliers to dissipate the heat.

59. Removal and Replacement

Note. Removal and replacement of the rf gear train assembly is performed at fourth echelon.

All subchassis, except the rf subchassis, can be removed from the receiver without prior removal of any of the other assemblies. When the rf and vfo subchassis are removed from the receiver, avoid changing the positions of the kilocycles and vfo tuning shafts, since this will necessitate synchronization checks. Where possible, preset the receiver controls before removing the subchassis. Subchassis mounting (captive) screws are color-coded with green heads. When removing a subchassis, loosen the captive screws enough to free them from the main frame. When replacing a subchassis, properly position the subchassis and start all captive screws before tightening them all the way. To remove a coaxial plug, press the plug in slightly and twist counterclockwise to release, then pull the plug straight out. Where coaxial plugs are not readily accessible, use Tube Puller TL-201 to remove the plugs. Do not loosen gear clamp screws too much; the clamp screw nuts may drop off. Excessive tightening of the clamp screws may strip the threads. Fully insert a Bristo wrench to avoid stripping the slots in the screwhead.

60. Receiver Case

a. Removal. Remove the receiver case as follows:

(1) Loosen the 10 captive Allen-head screws around the edges of the front panel by turning the screws counterclockwise until they are completely free of the case.
(2) Carefully tilt the receiver until it rests on its front panel.
(3) Lift off the case.

b. Replacement. Replace the receiver case as follows:

(1) Place the receiver on its front panel.
(2) Slip the case over the receiver.
(3) Carefully place the receiver in the normal position.
(4) Tighten the 10 captive Allen-head screws in the front panel.

61. Front Panel

a. Removal. To gain access to the parts mounted on the front panel or to prepare for removal of the upper deck assembly (para 63), remove the front panel as follows:

(1) Remove the receiver case (para 60).

(2) Remove the cable clamp from the bottom of the front cam guide plate (fig. 53).
(3) Disconnect plugs P111, P112, P113, and P106 from their associated receptacles (fig. 53 and 54).
(4) Disconnect plug P109 on the vfo jack board (fig. 53).
(5) Remove the cable clamp at the top left side of the receiver (fig. 54) by removing the two screws which secure the clamp to the left sideplate.
(6) Remove the three Phillips screws from the gear coverplate (fig. 54), and lift off the plate.
(7) Disconnect plug P206 (fig. 54).
(8) Loosen the setscrews on the ANT TRIM flexible shaft (fig. 54) coupling at the front panel end, and remove the flexible shaft and coupling.
(9) Loosen the setscrews in the MEGACYCLES and the KILOCYCLES knobs, and remove the knobs.
(10) Remove the DIAL LOCK knob. Loosen the nut and washer on the DIAL LOCK bushing, and rotate the dial lock (fig. 55) to clear the kilocycle disk (fig. 56).
(11) Remove the BAND WIDTH knob.
(12) Remove the 10 flat-head Phillips screws which secure the front panel to the sideplates of the receiver.
(13) Pull the front panel away from the receiver.

b. Replacement. Replace the front panel as follows:

(1) Bring the front panel into place against the receiver.
(2) Replace and tighten the 10 flat-head Phillips screws which secure the front panel to the sideplates of the receiver.
(3) Rotate the dial lock mechanism so that the jaws of the dial lock are in position to grasp the kilocycle disk (fig. 55 and 56).
(4) Tighten the nut on the DIAL LOCK bushing. Be sure the dial lock mechanism is in the proper position.
(5) Replace the DIAL LOCK knob.
(6) Replace the BAND WIDTH knob.
(7) Replace the MEGACYCLES and KILOCYCLES knobs and tighten the setscrews.
(8) Replace the flexible shaft coupling onto the ANT TRIM coupling at the front panel and tighten the setscrews.
(9) Connect plug P206 to receptacle J106 (fig. 54).
(10) Replace the gear cover plate (fig. 54).
(11) Replace the cable clamp located at the top left side of the receiver (fig. 54).
(12) Connect plug P109 to receptacle J809 on the vfo jack board (fig. 53).
(13) Connect the following plugs in their associated receptacles: P111 in J611, P112 in J612, P113 in J613 and P106 in J206 (fig. 53 and 54).
(14) Replace the cable clamp at the bottom of the front cam guide plate (fig. 53).
(15) Replace the receiver case (para 60).

62. Lower Deck Assembly (fig. 53)

The lower deck assembly, which consists of af, if., and calibration oscillator subchassis is removed as a single unit.

a. Removal. The lower deck assembly can be removed from the receiver without prior removal of the front panel, upper deck assembly, or vfo subchassis. Proceed as follows:

(1) Remove the receiver case (para 60) and place the receiver on the workbench with the lower deck assembly up.
(2) Remove the cable clamp from the front cam guide plate.
(3) Disconnect plugs P810, P111, P112, and P113 from their associated receptacles.
(4) Loosen the five green captive screws which secure the lower deck assembly to the floor plate.

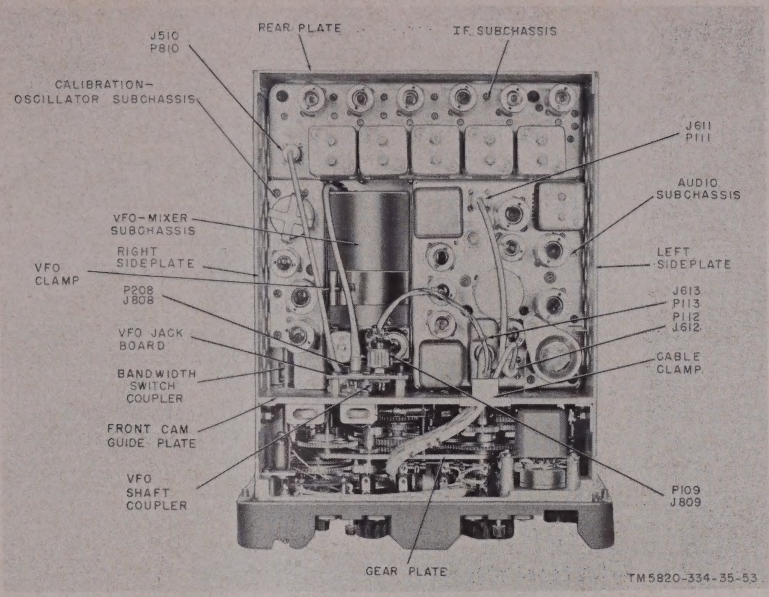


Figure 53. Receiver, bottom view, case removed.

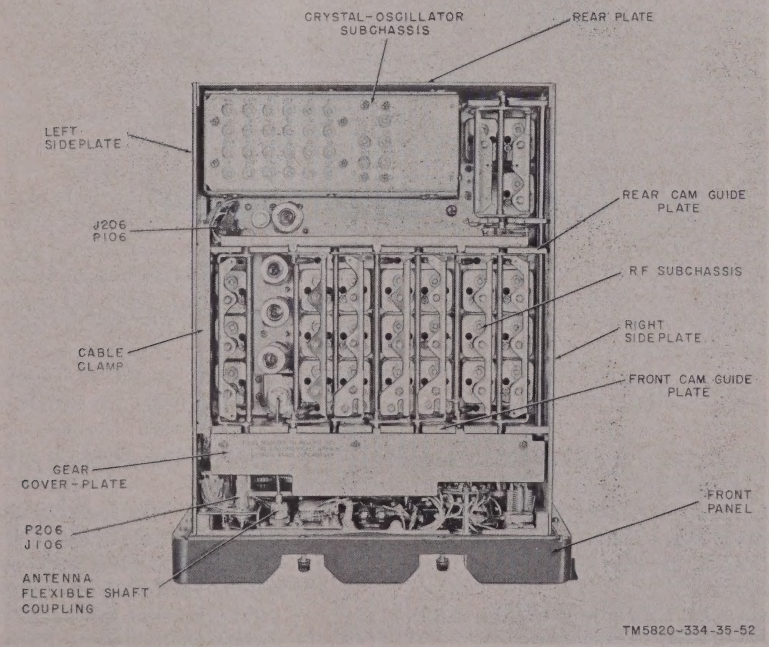


Figure 54. Receiver, top view, case removed.

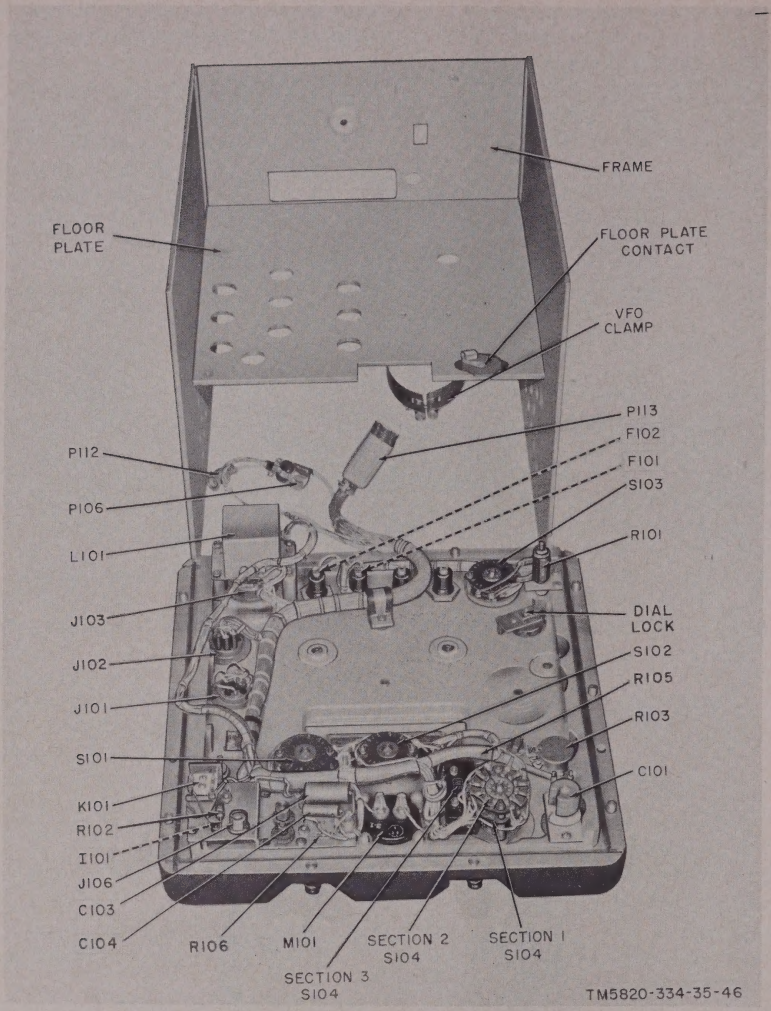


Figure 55. Front panel assembly, rear view.

(5) Slide the lower deck assembly back and lift straight up from the frame. The BAND WIDTH switch coupler (Oldham type) insert will drop out; secure it to the sideplate of the receiver.

b. Replacement. Replace the lower deck assembly as follows:

(1) Replace the insert in the BAND WIDTH switch coupler (Oldham type).

(2) Lower the lower deck assembly into position. Make sure the cable attached to plug P810 is held clear when lowering the assembly into place so that the cable will not become wedged between the assembly and receiver frame.

(3) Tighten the five green captive screws which secure the lower deck assembly to the floor plate.
(4) Connect the following plugs to their associated receptacles: P810, P111, P112, and P113.
(5) Replace the cable clamp on the front cam guide plate.
(6) Replace the case (para 60).

63. Upper Deck Assembly

(fig. 53 and 54)

The upper deck assembly, which consists of the rf and crystal oscillator subchassis, is removed as a single unit.

a. Removal. To remove the upper deck assembly from the receiver, set the KILOCYCLES control to a KILOCYCLES dial reading of 000 and remove the front panel (para 61). Although it is not imperative, removal of the lower deck assembly (para 62) facilitates removal of the upper deck assembly. Proceed as follows:

Note. After removal of the front panel, make certain that the KILOCYCLES dial reading of 000 has not been disturbed. If the setting has changed, readjust with the kilocycles control shaft.

(1) Disconnect plug P208 on the vfo jack board.
(2) Remove the two screws which secure the vfo jack board.
(3) Remove the roundhead Phillips screw which secures the upper deck assembly to the rear plate.
(4) Remove the eight flathead Phillips screws which secure the rear cam guide plate to the sideplates.
(5) Loosen the two green captive screws at the top rear corners of the rf subchassis.
(6) Remove the upper deck assembly by pulling the assembly forward, then upward. The BAND WIDTH switch coupler insert will drop out; secure the insert to the sideplate. Be careful not to damage the coaxial cable attached to plug P208. The vfo coupler insert will drop down; secure it to the sideplate of the receiver.

b. Replacement. If the position of the vfo tuning shaft has not been changed, make sure that the KILOCYCLES dial setting is 000, and replace the upper deck assembly in the receiver as directed. If the position of the vfo tuning shaft has been changed, adjust the vfo (para 64e) before proceeding.

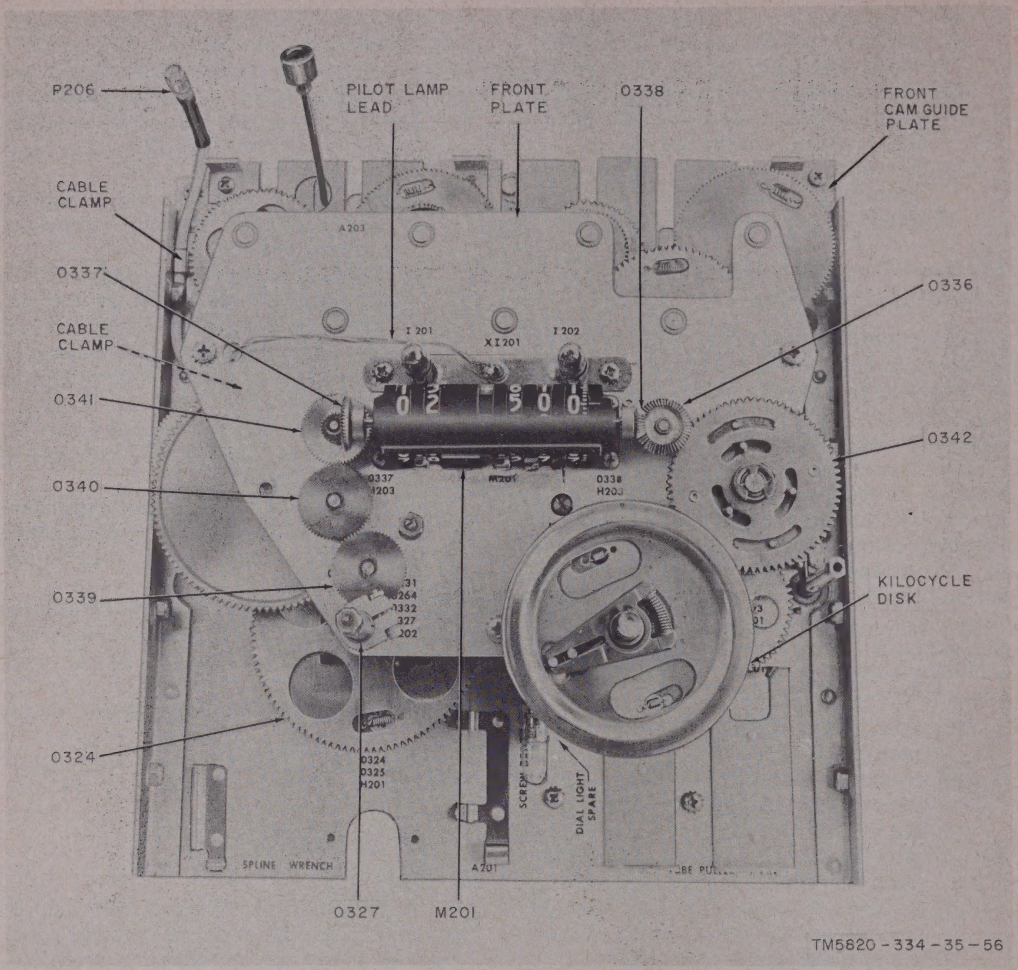
(1) Place the receiver on its rear plate on the bench.
(2) Set the vfo coupler insert and the BAND WIDTH switch coupler insert in place.
(3) Insert the cable (attached to P208) through the hole in the floor plate.
(4) Gently slip the upper deck assembly in place, observing that the couplers are aligned properly in the inserts.
(5) Tighten the two green captive screws at the top rear corners of the rf subchassis.
(6) Replace and tighten the eight flathead Phillips screws which secure the rear cam guide plate to the sideplates.
(7) Replace and tighten the roundhead Phillips screw which secures the upper deck assembly to the rear plate.
(8) Replace the two screws and secure the vfo jack board.
(9) Connect P208 to J808 on the vfo jack board.

64. Vfo Subchassis

(fig. 53)

a. Removal. The vfo subchassis can be removed from the receiver without prior removal of any of the other assemblies. Proceed as follows:

(1) Set the KILOCYCLES dial at 500 (last three digits on frequency indicator dial).
(2) Disconnect plugs P208 and P109.
(3) Remove the two Phillips screws from the vfo jack board.
(4) Remove the screw from the vfo clamp.
(5) Slide the vfo subchassis toward the rear of the receiver to disengage the vfo shaft coupler and lift out the subchassis. The vfo shaft coupler insert will drop out; secure it to the receiver.



0324 Gear, antibacklash 100-tooth
0327 Gear, spur, 36-tooth
0336 Gear, bevel and spur
0337 Gear, bevel, 48-tooth
0338 Gear, bevel, 24-tooth
0339 Gear, spur, 64-tooth
0340 Gear, spur, 64-tooth
0341 Gear assembly, bevel and spur
0342 Clutch assembly

Figure 56. Upper deck assembly, front view.

b. Replacement Procedure, Vfo Shaft Position not Changed.

(1) Be sure that the KILOCYCLES dial is at the reference setting of 500 and the vfo shaft has not been turned.
(2) Place the vfo subchassis in position in the receiver slightly to the rear of its normal position.
(3) Replace the insert in the vfo shaft coupler.
(4) Slide the vfo subchassis toward the front of the receiver, at the same time engaging the vfo shaft coupler.

(5) Replace and tighten the screw in the vfo clamp.
(6) Bring the vfo jack board into place; replace and tighten the two Phillips screws.
(7) Replace plugs P208 and P109.

c. Replacement Procedure, Vfo Shaft Position Changed.

(1) Be sure the KILOCYCLES dial is set at 500.
(2) Place the vfo subchassis in position in the receiver slightly to the rear of its normal position. Do not connect the vfo shaft coupler.
(3) Bring the vfo jack board into place; replace and tighten the two Phillips screws.
(4) Replace plugs P208 and P109.
(5) Place a lead connected to the ANT post of another Radio Receiver R-392/URR (called a test receiver in this procedure) near vfo-mixer tube V801 of the receiver being repaired.
(6) Set the MEGACYCLES control of the test receiver to a MEGACYCLES dial reading of 02 and the KILOCYCLES control to a KILOCYCLES dial reading of 455.
(7) Connect a headset to the test receiver.
(8) Set the BFO PITCH control to 0 and the BFO switch to ON on the test receiver.
(9) Turn the KILOCYCLES control of the test receiver clockwise until a zero beat is obtained. (Tap the vfo-mixer tube of the receiver being repaired and listen for sound in the test receiver headset to make certain the beat is with the signal from the vfo.)
(10) Turn the KILOCYCLES control of the test receiver toward a KILOCYCLES dial reading of 955; at the same time, turn the vfo shaft of the receiver being repaired, maintaining a beat note in the headset, until a dial reading of 955 on the test receiver is reached. Turn the vfo shaft for a zero beat at this dial reading.
(11) Replace the insert in the vfo shaft coupler, slide the vfo subchassis forward and, at the same time, engage the vfo shaft coupler.
(12) Replace and tighten the screw in the vfo clamp.

Note. The procedure given in *c*(1) through (12) above is designed to prevent damaging the vfo by turning its shaft beyond the mechanical limits during subsequent alignment of the receiver.

(13) Synchronize the vfo tuning shaft as described in paragraph 79.

65. Crystal Oscillator Subchassis (fig. 57)

a. Removal. Remove the upper deck assembly from the receiver before removing the crystal oscillator subchassis (para 63). Remove the crystal oscillator subchassis from the upper deck assembly as follows:

(1) Disconnect plugs P401, P402, and P403.
(2) Remove the two Phillips screws which secure the crystal oscillator subchassis to the rear of the rf subchassis.
(3) Separate the crystal oscillator subchassis from the rf subchassis. The crystal oscillator Oldham coupler insert will drop out; secure it to the receiver.

b. Replacement. Replace the crystal oscillator subchassis as follows:

(1) Place crystal oscillator subchassis in position against the rf subchassis.
(2) Place the insert in the Oldham coupler and fit the coupler sections together.
(3) Replace the two screws which secure the crystal oscillator subchassis to rear of the rf subchassis.
(4) Connect the following plugs and receptacles: P401 to J201, P402 to J202, and P403 to J203.
(5) Check the synchronization of the crystal oscillator subchassis and adjust if necessary (para 74 and 78).

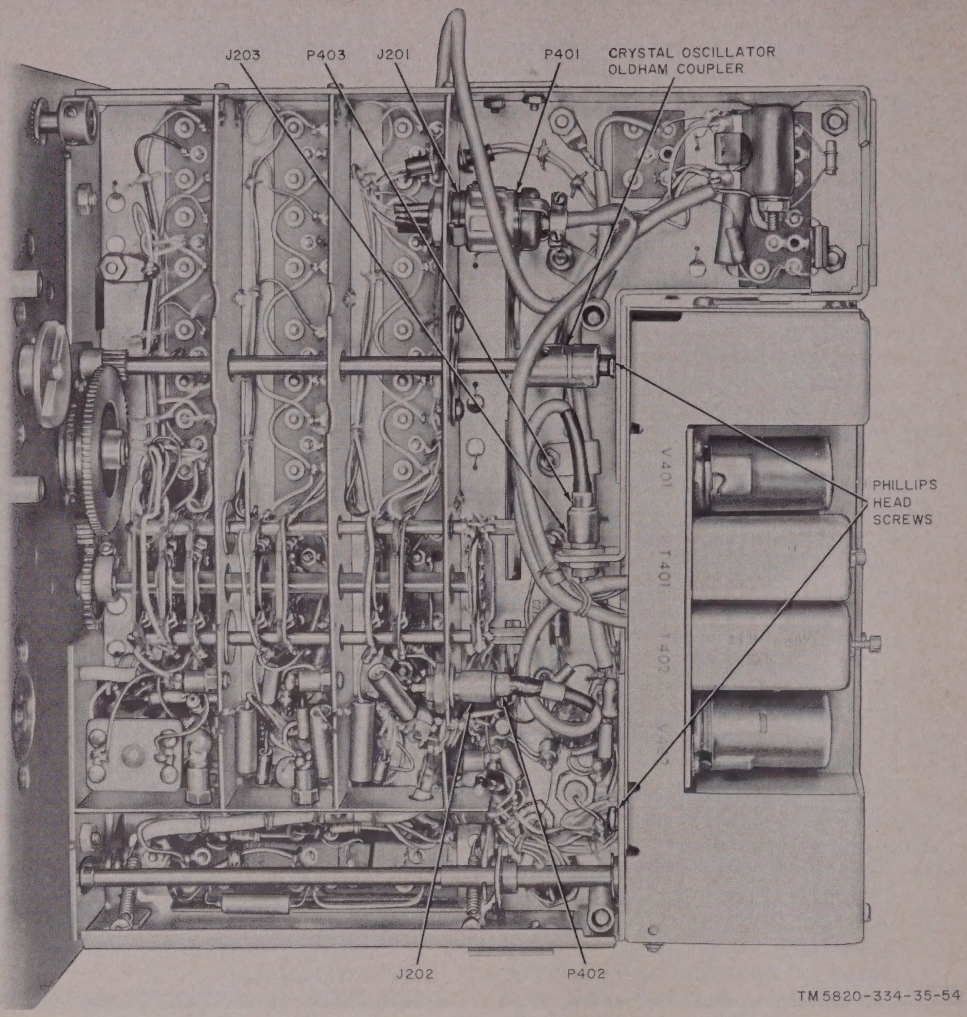


Figure 57. Upper deck assembly and crystal oscillator subchassis, bottom view.

66. Rf Tuning Coils and Transformers (fig. 59)

a. Removal. Remove the rf tuning coils and transformers by first removing the upper deck assembly (para 63). Proceed as follows:

(1) Remove the eight screws on the cam guide bracket on the rear cam guide plate and remove the bracket.

(2) To remove the slug rack associated with a coil or transformer, unhook the spring located at each end of the slug rack and remove the slug rack. Be careful that the springs do not fall into the subchassis.

(3) Insert a small Phillips screwdriver carefully into the two holes

in the coil or transformer can, and loosen the screws until they are free of the subchassis.

(4) Withdraw the coil or transformer from the subchassis.

b. Replacement. Replace the rf tuning coils and transformers as follows:

(1) Plug the coil or transformer into its socket.

(2) Replace the two small Phillips screws into the holes in the coil or transformer can and tighten them.

(3) Replace the slug rack associated with the coil or transformer and hook the spring located at each end of the slug rack.

(4) Replace the cam guide bracket on the rear cam guide plate, and replace and tighten the eight screws.

67. Removing and Replacing Parts in Mechanical Tuning System

Note. Removal and replacement of the rf gear train assembly (*m* and *n* below) is performed at fourth echelon.

a. Removal of Frequency Indicator M201 (fig. 56).

(1) Remove the receiver from the case (para 60).

(2) Remove the front panel from the receiver (para 61).

(3) Note the frequency indicated on M201. *Do not turn the MEGACYCLES or KILOCYCLES controls during this procedure.*

(4) Remove the four Phillips screws which hold frequency indicator M201.

(5) Remove frequency indicator M201.

b. Replacement of Frequency Indicator M201 (fig. 56).

(1) Set frequency indicator M201 to read the same frequency as before removal (*a*(3) above).

(2) Align frequency indicator M201 with the mounting holes on the front plate.

(3) Replace the four screws which hold frequency indicator M201.

(4) Replace the front panel (para 61).

(5) Replace the receiver in the case (para 60).

c. Removal of Spur Gear 0339 or 0340 (fig. 56).

(1) Remove the receiver from the case (para 60).

(2) Remove the front panel from the receiver (para 61).

(3) Remove the retaining ring from the gear shaft and remove the spur gear.

d. Replacement of Spur Gear 0339 or 0340 (fig. 56).

(1) Replace the gear and secure with retaining ring.

(2) Replace the front panel (para 61).

(3) Replace the receiver in the case (para 60).

e. Removal of Gear Assembly 0341 (fig. 56).

(1) Remove frequency indicator M201 (*a* above).

(2) Remove gear assembly 0341 from its shaft.

f. Replacement of Gear Assembly 0341 (fig. 56).

(1) Slip gear assembly 0341 on its shaft.

(2) Replace frequency indicator M201 (*b* above).

g. Removal of Bevel Gear 0337 or 0338 (fig. 56).

(1) Remove frequency indicator M201 (*a* above).

(2) Loosen the clamp screw for the bevel gear and remove the bevel gear.

h. Replacement of Bevel Gear 0337 or 0338 (fig. 56).

(1) Slip the bevel gear on the shaft.

(2) Replace frequency indicator M201 (*b*(1), (2), and (3) above).

(3) Set frequency indicator M201 to indicate the same frequency as before removal (*a*(3) above).

(4) Position the bevel gear firmly against the gear assembly and tighten the clamp screw on the bevel gear.

(5) Replace the front panel (para 61).

(6) Replace the receiver in the case (para 60).

i. Removal of Clutch Assembly 0342 and Bevel and Spur Gear 0336 (fig. 56 and 58).

(1) Remove frequency indicator M201 (*a* above).
(2) Loosen the clamp screw below gear 0329 and remove the kilocycle disk and gear 0329 from shaft 0331.
(3) Remove the retaining ring from the clutch assembly shaft.
(4) Remove bevel and spur gear 0336, along with clutch assembly 0342, from its shaft.

j. Replacement of Clutch Assembly 0342 and Bevel and Spur Gear 0336 (fig. 56 and 58).

(1) Place clutch assembly 0342 and bevel and spur gear 0336 on their shafts. Load the split gear of 0342 two teeth and mesh with the spur gear of 0336.
(2) Replace the retaining ring on the clutch assembly shaft.
(3) Load gear 0329 (fig. 57) two teeth and replace the kilocycle disk and gear 0329 on shaft 0331; mesh gear 0329 with the brass gear of clutch assembly 0342.
(4) Tighten the clamp screw below gear 0329.
(5) Replace frequency indicator M201 (*b* above).

k. Removal of Gears 0329 and 0330 (fig. 58).

(1) Loosen the clamp below gear 0329.
(2) Remove the kilocycle disk, gear 0329, and the clamp from shaft 0331.
(3) Remove the retaining ring for gear 0330.
(4) Slip gears 0329 and 0330 away from the kilocycle disk.
(5) Unhook the loading springs from gears 0329 and 0330 and separate the gears.

l. Replacement of Gears 0329 and 0330 (fig. 56 and 58).

(1) Place gear 0330 against gear 0329 and hook the two loading springs in the holes provided in the gears.
(2) Place the assembly of gears 0329 and 0330 against the kilocycle disk with the pin of gear 0330 through the fork on the kilocycle disk (fig. 56).
(3) Replace the retaining ring for gear 0329.
(4) Replace the clamp on the sleeve of gear 0330.
(5) Slip the kilocycle disk and gears 0329 and 0330 on shaft 0331.
(6) Load gears 0329 and 0330 two gear teeth.
(7) Turn the assembly until the slot in the 0330 sleeve is aligned with the pin in shaft 0331.
(8) Engage the gears of the assembly with the brass gear of the clutch assembly. Do not lose the loading.
(9) Move the gear assembly along the shaft so the split gears are centered on the brass gear of clutch assembly 0342.
(10) Tighten the screw in the clamp on gear 0330. Do not overtighten.

m. Removal of Gear Train Assembly from Rf Subchassis (fig. 59-62). Remove the upper deck assembly (para 63) before removing the gear train assembly from the rf subchassis. Remove the gear train assembly as follows:

(1) Set the MEGACYCLES and KILOCYCLES controls for a reading of 02300 on the frequency indicator.
(2) Remove the crystal oscillator from the rf subchassis (para 65).
(3) Remove the cam guide bracket on the rear cam guide plate (fig. 59).
(4) Unhook all slug rack springs (fig. 59).
(5) Remove all slug racks (fig. 59). Work carefully to avoid damage or breakage. Identify each slug rack with a pencil mark so that they can be replaced in the proper cam guide slot.
(6) Unhook the first variable if. cam rack springs (fig. 60).
(7) Remove all rf tuning coils and transformers as follows:
(a) Insert a small Phillips screwdriver carefully into the two holes in a coil or transformer can, and loosen the screws until they are free of the subchassis.
(b) Withdraw the coil or transformer from the subchassis.

(c) Mark the coils and transformers for identification.

(8) Remove the tubes from the subchassis.

(9) Loosen the clamp screw for gear 0274 (fig. 60).

(10) Slip the shaft for S201 out of the gear clamp. This can be done with long-nosed pliers (fig. 60).

(11) Unsolder the pilot lamp lead from the solder lug above frequency indicator M201 on the front panel (fig. 56).

(12) Remove the two screws in the guide bracket that holds the flexible coupling, which normally connects between the ANT TRIM control and capacitor C202 (fig. 59). Slip the coupling through the hole in the front cam guide plate.

(13) Remove the two cable clamps which hold the lead to P206 to the front cam guide plate (fig. 56).

(14) Loosen the Oldham coupler on shaft 0295 and remove it from the shaft (fig. 60).

(15) Remove the shaft guide from shaft 0295 (fig. 60).

(16) Remove the four second variable if. cam guide nuts (fig. 60).

(17) Remove the two screws from the mounting brackets on each side of the rf subchassis (fig. 61 and 62).

(18) Remove the two gear assembly mounting screws and nuts (fig. 60).

(19) Remove the retaining ring at the rear of shaft 0294 (fig. 60) and slip the shaft out of the rear bearing.

(20) Carefully move the rf subchassis down and away from the gear train assembly as follows:

(a) Guide the dial lamp lead and the lead to P206 through the holes in the front cam guide plate as the chassis is pulled away (fig. 56).

(b) Slip shaft 0295 through the holes in the shield plates in the bottom of the rf chassis (fig. 60).

(c) Work the cam on shaft 0294 through the oval hole in the front of the rf subchassis (fig. 60).

n. Replacement of Gear Train Assembly (fig. 59-62). Replace the gear train assembly as follows:

(1) Bring the rf subchassis into place against the gear train assembly as follows:

(a) Work the cam on shaft 0294 through the oval hole in the front of the rf chassis (fig. 60).

(b) Slip shaft 0295 through the holes in the shield plates in the rf subchassis (fig. 60).

(c) Guide the dial lamp lead and the lead to P206 through the holes in the front cam guide plate (fig. 56).

(d) Slip shaft 0294 into the bearing at the rear of the chassis (fig. 60).

(2) Replace and tighten the two screws and nuts which secure the rf subchassis to the gear train assembly (fig. 60).

(3) Replace and tighten the two screws in the mounting brackets on each side of the rf subchassis (fig. 61 and 62).

(4) Replace the retaining ring at the rear bearing of shaft 0294 (fig. 60).

(5) Replace and tighten the four second variable if. cam guide mounting nuts (fig. 60).

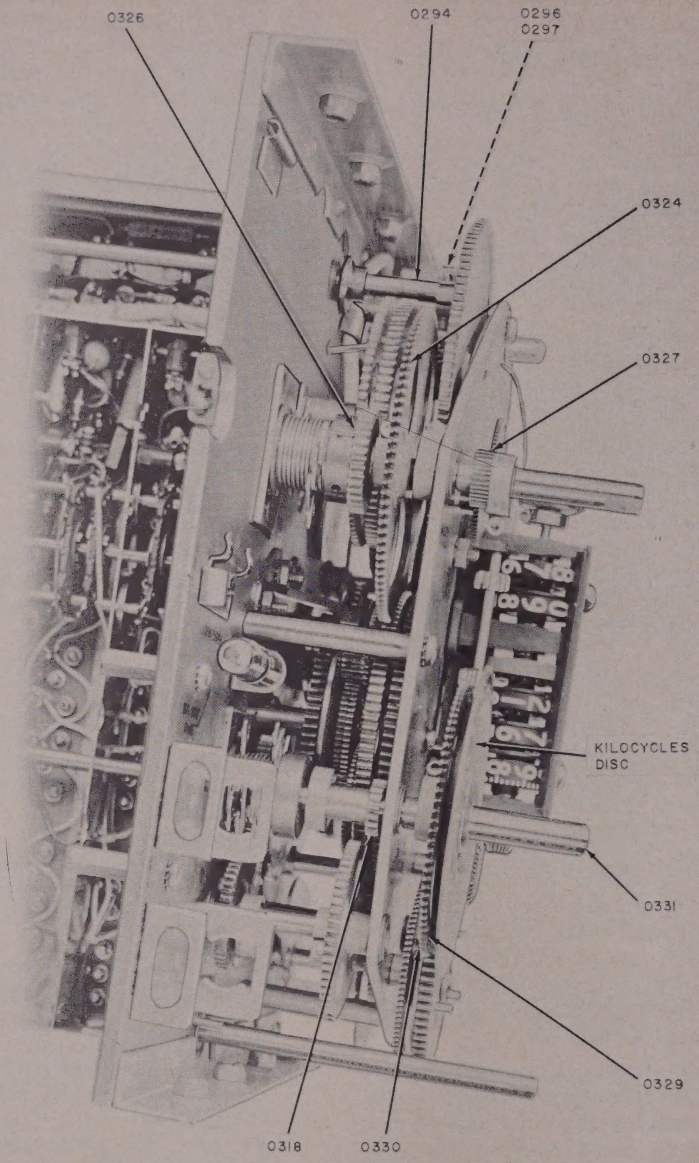
(6) Slip the shaft guide on shaft 0295. Start the screws, center the shaft guide, and tighten the two screws (fig. 60).

(7) Slip the Oldham coupler on shaft 0295 and tighten the setscrews (fig. 60).

(8) Slip the shaft for S201 into the clamp for gear 0274 and tighten the clamp screw (fig. 60). Do not overtighten.

(9) Bring the pilot lamp lead through the hole provided in the front plate and solder it to the lug above frequency indicator M201 (fig. 56).

(10) Slip the coupling, which normally connects between the ANT TRIM control and capacitor C202 (fig. 59), through the hole in the front



0294	Shaft, 1st variable if. cam	0326	Gear, spur, 32-tooth
0296 and 0297	Gear assembly, antibacklash, 72-tooth	0327	Gear, spur, 36-tooth
0318	Gear, spur, 17-tooth	0329 and 0330	Gear assembly, antibacklash, 90-tooth
0324	Gear, antibacklash, 100-tooth	0331	Shaft, kilocycles

Figure 58. Gear assembly, bottom view.

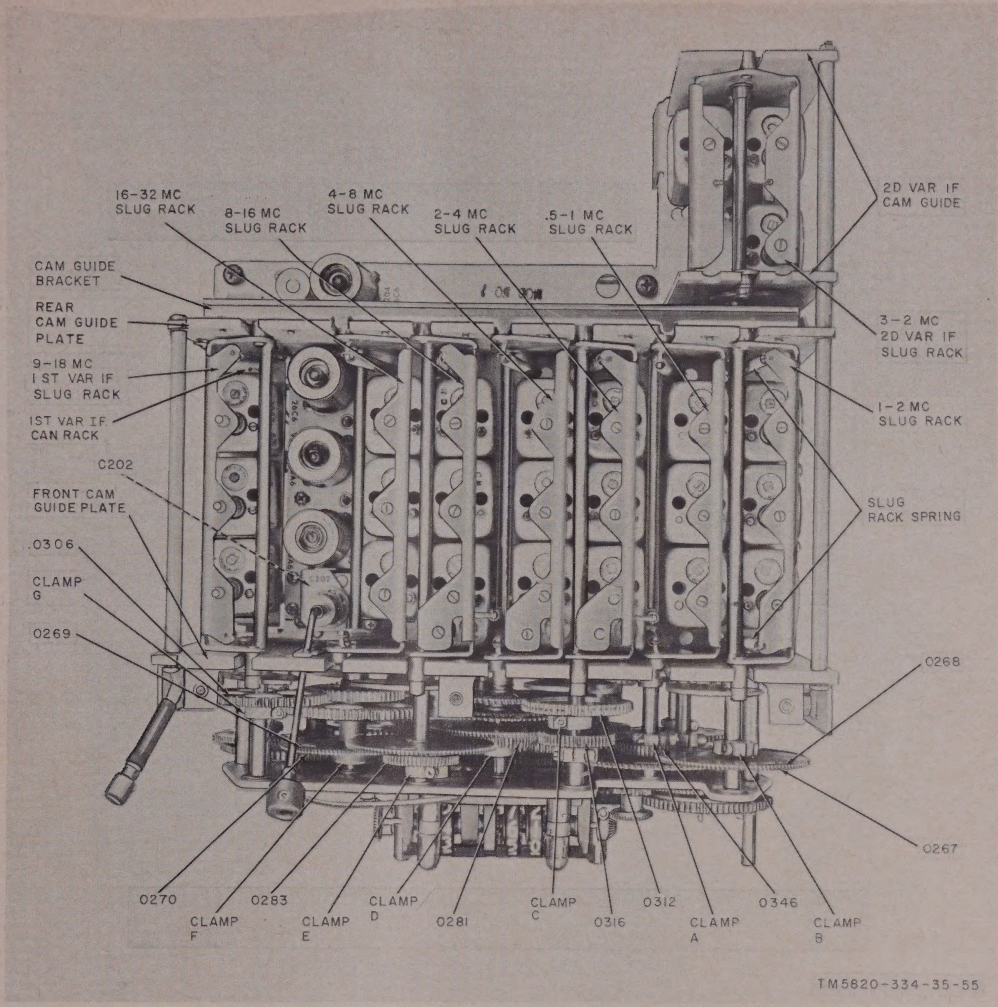


Figure 59. Gear train assembly and rf subchassis, top view.

cam guide. Mount the flexible coupling guide bracket with two screws.

(11) Replace the two cable clamps that hold the lead to P206 to the front cam guide plate (fig. 56).

(12) Replace all rf tuning coils and transformers as follows:

(a) Place each coil or transformer in its proper socket (fig. 43).

(b) Insert the mounting screws in the two holes of the can and carefully tighten them with a small Phillips screwdriver.

(13) Replace all slug racks. Work carefully to avoid breakage or damage to the slugs. Be sure each slug rack is placed in the proper cam guide slots.

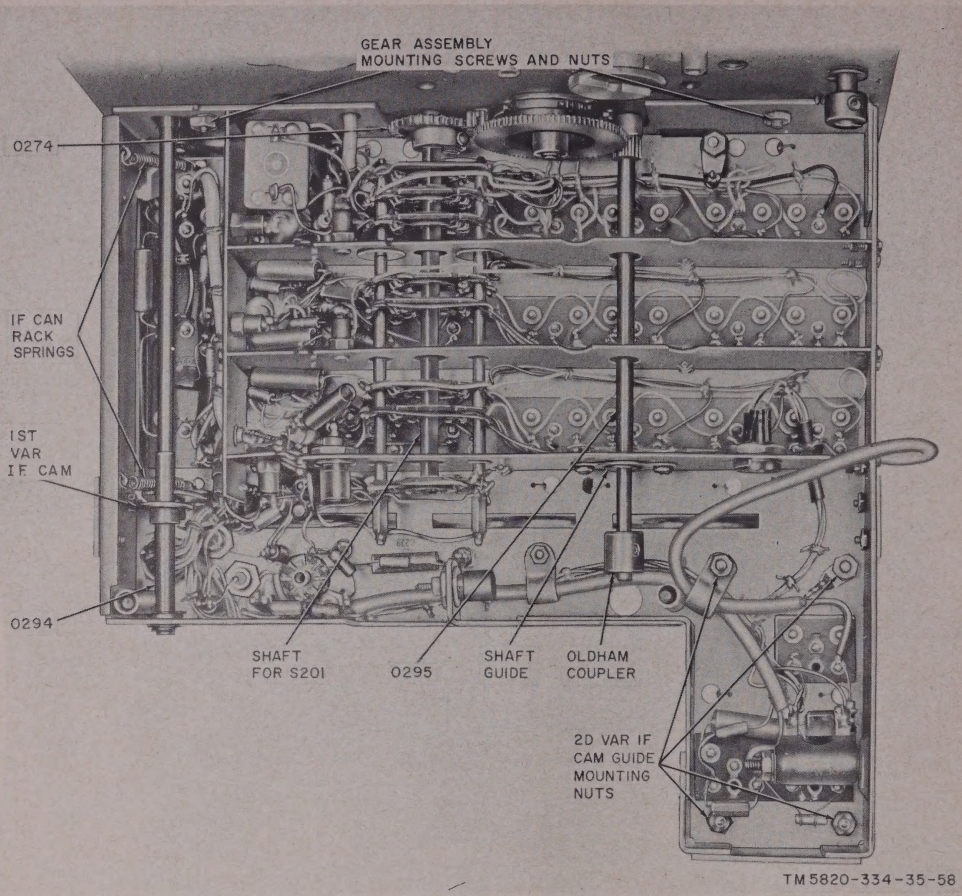


Figure 60. Rf subchassis, bottom view.

(14) Replace all slug rack springs (fig. 59).
(15) Replace the first variable if. can rack springs (fig. 60).
(16) Replace all tubes and tube shields in the rf subchassis (fig. 43).
(17) Replace the cam guide bracket on the rear cam guide plate (fig. 59).
(18) Replace the crystal oscillator subchassis (para 65).
(a) If shaft 0295 is out of line with the crystal oscillator shaft, loosen the two screws in the shaft guide for shaft 0295 (fig. 60), align the shafts, and tighten the screws in the shaft guide.
(b) Loosen the setscrew in the Oldham coupler at the end of shaft 0295 and fit the coupler insert to the two sections of the coupler (fig. 57). Tighten the setscrew in the coupler.
(19) Check the synchronization of six-position rf bandswitch S201 and adjust if necessary (para 80).
(20) Check the synchronization of crystal oscillator bandswitch S401 and adjust if necessary (para 74).

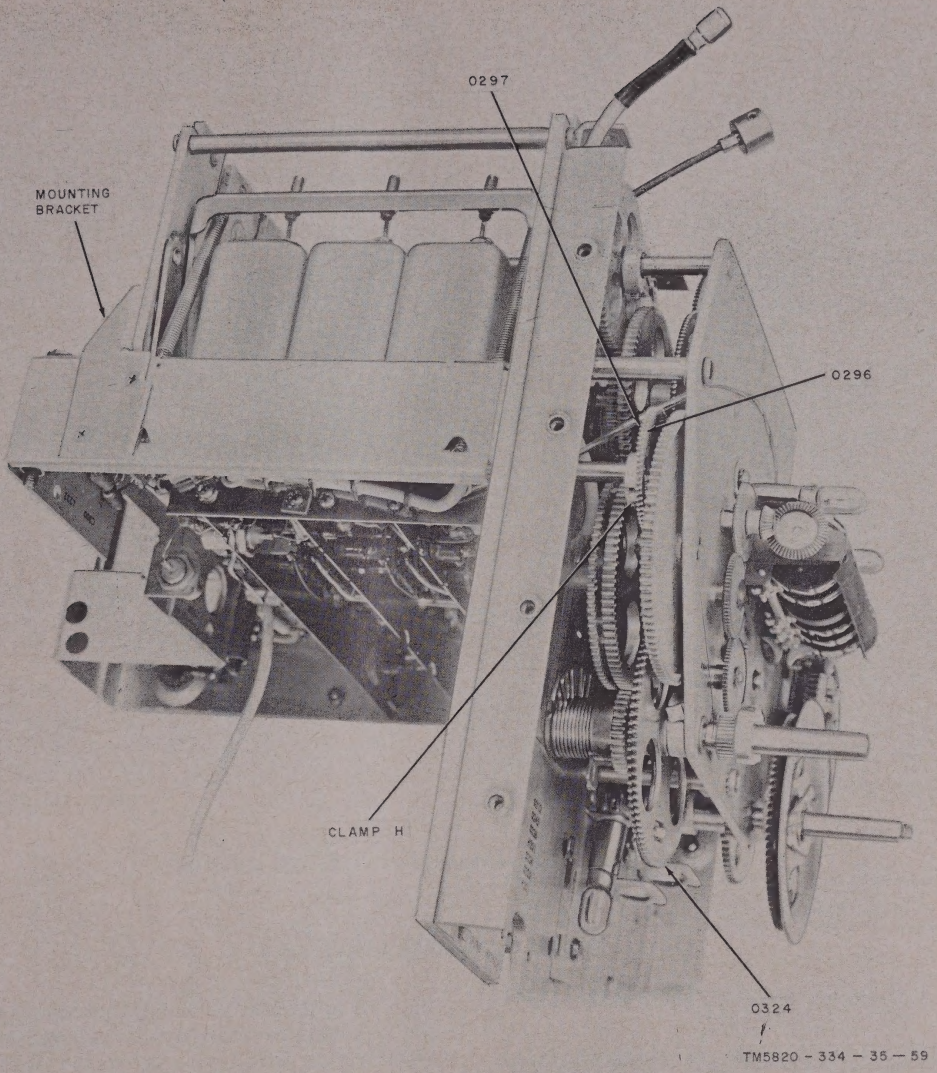


Figure 61. Gear train assembly and rf subchassis, left view.

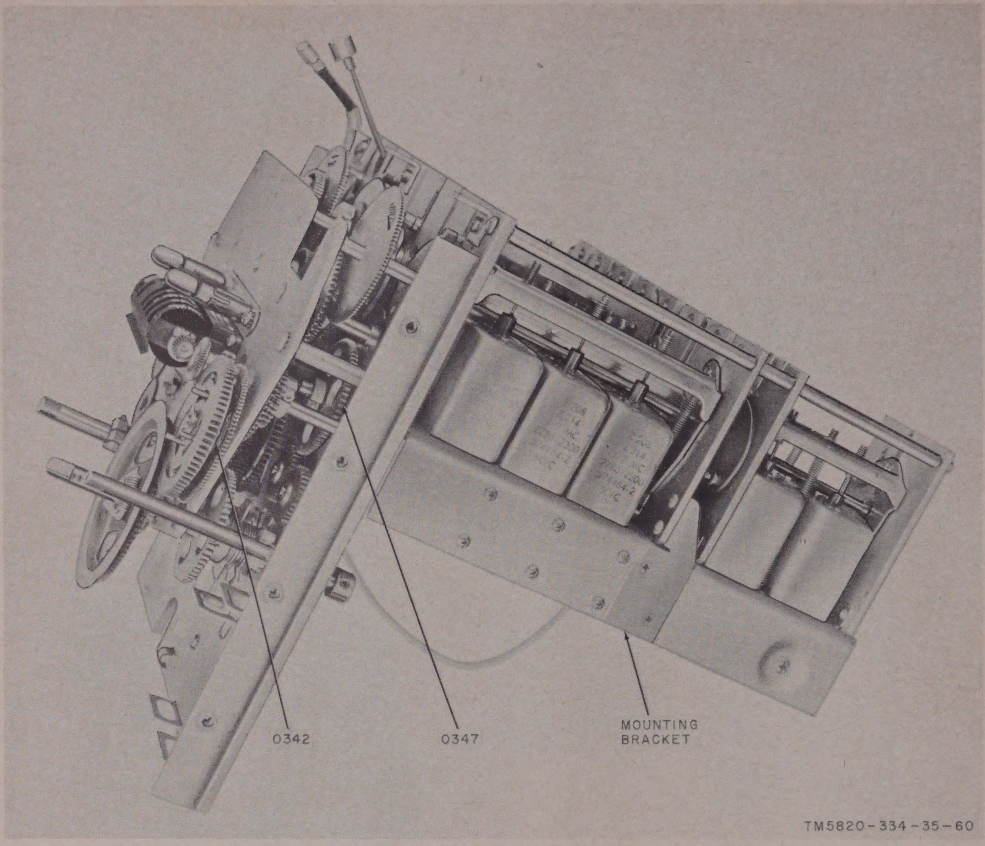


Figure 62. Gear train assembly and rf subchassis, right view.

Section II. LUBRICATION

68. Lubrication Intervals and Precautions

The only part of the receiver which requires lubrication is the mechanical tuning system. The system is lubricated initially at the factory and should be lubricated thereafter once every 6 months, under normal operating conditions. The lubrication interval should be shortened only if the need is indicated by inspection or if abnormal conditions or activities are encountered. It must be remembered that overlubrication can often cause more harm than no lubrication. Check the condition of the mechanical tuning system whenever the receiver is withdrawn from the case for servicing. Work the KILOCYCLES and MEGACYCLES controls, and check for ease of operation. Check for lack of lubricant on gears, edges of cams, guide slots, and bearings; inspect for gritty grease and oil.

Caution: **Never attempt to lubricate the sealed vfo, regardless of possible noisy operation during its tuning, or unstable operation of the oscillator may result.**

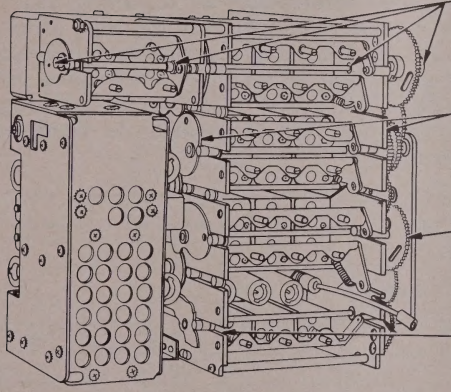
69. Cleaning

Loosen the 10-captive Allen-head screws around the edge of the front panel, and withdraw the receiver from its case (para 60). Remove the three Phillips screws from the gear cover plate (fig. 54) and remove the plate. Using a thin, long-handled, medium-bristled brush dipped in cleaning compound, remove all dirt, oil, and grease from the gears, cams, guide slots, and bearings. To gain access to all the gear teeth while cleaning, rotate the MEGACYCLES and KILOCYCLES knobs. After dipping the brush in cleaning compound, remove excess compound to prevent drops from falling onto connecting cables, wiring, or other electrical parts. Use a clean, lint-free cloth moistened with cleaning compound to remove grease from gear plates and chassis. Thoroughly wipe all parts with a clean, dry, lint-free cloth before proceeding with lubrication.

Warning: **Cleaning compound is flammable and its fumes are toxic. Do not use near a flame and provide adequate ventilation.**

70. Lubrication

Lubricate the mechanical tuning system as indicated in figure 63. The illustration shows the upper deck assembly removed from the receiver. To perform lubrication, remove the receiver from the case (para 60) and remove the gear cover plate (fig. 54). To apply oil to the bearings, dip a length of wire into the oil to collect a small drop at the end, and transfer the oil to the bearing by touching the end of the wire to the edge of the bearing. Avoid the use of excessive amounts of oil. A



UPPER DECK ASSEMBLY
TOP VIEW
(DO NOT REMOVE FOR LUBRICATION)

INTERVAL	LUBRICANT	
6M	MIL-L-644A	CAMSHAFT AND GEAR-SHAFT BEARINGS 1 OR 2 DROPS. OPERATE TO SPREAD.
6M	MIL-G-3278	SLUG RACK CAMS CLEAN AND APPLY THIN FILM ON EDGES.
6M	MIL-G-3278	TUNING MECHANISM GEARS CLEAN AND COAT TEETH SPARINGLY, REMOVE EXCESS LUBRICANT. OPERATE TO SPREAD.
6M	MIL-G-3278	GUIDE SLOTS CLEAN AND APPLY THIN FILM. OPERATE TO SPREAD.

CLEANING—SOLVENT, DRY-CLEANING, ONLY WILL BE USED TO CLEAN PARTS. BEFORE LUBRICATING CLEAN SURFACES OF PARTS WITH LINTLESS CLOTH LIGHTLY DAMPENED WITH SOLVENT, DRY-CLEANING. DO NOT ALLOW CLEANING FLUID TO GET ON OTHER PARTS OF RECEIVER.

LUBRICANTS	INTERVAL
MIL-L-644A-LUBRICATING-OIL, PRESERVATIVE, SPECIAL. LOW TEMPERATURE.	6M-6 MONTHS
MIL-G-3278-GREASE, AIRCRAFT AND INSTRUMENTS. LOW AND HIGH TEMPERATURES	

TM5820-334-35-61

Figure 63. Radio Receiver R-392/URR, lubrication.

standard grease gun and a thin, long-handled brush should be used for applying grease to gear teeth, edges of cams, and tuning-rack guide slots. Rotate the MEGACYCLES and KILOCYCLES controls as necessary to expose all gear teeth.

Section III. SYNCHRONIZING MECHANICAL TUNING SYSTEM

71. Checking and Synchronizing Mechanical and Electrical System

The following procedures are used for checking and synchronizing the mechanical and electrical system. Paragraphs 72 through 75 outline the procedure for checking the mechanical and electrical synchronization and *must be carried out in the order given, otherwise the entire mechanical system will be misaligned.* Paragraphs 76 through 81 outline the procedure for synchronizing the mechanical and electrical system.

72. Checking Synchronization of Frequency Indicator Dial with MEGACYCLES and KILOCYCLES Control Shaft Stops

Check the synchronization of the indicator dial with the control stops as follows:

a. Turn the KILOCYCLES control slowly clockwise until the stop is reached. The KILOCYCLES dial reading should be between +015 and +035.

b. Turn the KILOCYCLES control slowly counterclockwise until the stop is reached. The KILOCYCLES dial should be between -985 and -965.

c. Turn the MEGACYCLES control clockwise until the stop is reached. The MEGACYCLES dial reading should be halfway between 31 and 32.

d. Turn the MEGACYCLES control counterclockwise until the stop is reached. The MEGACYCLES dial reading should be halfway between 00 and 99.

e. If the indications in *a* through *d* above are not obtained, proceed with paragraph 73.

73. Checking Rf Cam Synchronization

Determine whether the rf cams are synchronized by removing the receiver from its case (para 60), setting the frequency indicator to each of the readings listed in the first column of the following chart, and checking to see that the slug or can rack (fig. 59) listed opposite the frequency is at the top of its rise. If a slug or can rack is more than 1/32 inch from the top of its rise, synchronization is required (para 77).

Frequency indicator reading			Slug racks						1st variable if. slug rack	1st variable if. can rack	2d variable if. slug rack
Mc	±	Kc	1-2 mc	0.5-1 mc	2-4 mc	4-8 mc	8-16 mc	16-32 mc			
Any	–	075								Top	Top
Any	+	025	Top	Top							
03	+	025			Top						
07		Any							Top		
07	+	025				Top			Top		
15	+	025					Top				
31	+	025						Top			

74. Checking Crystal Oscillator Bandswitch S401 Against Frequency Indicator Dial

Check crystal oscillator bandswitch S401 by comparing the MEGACYCLES reading on the frequency indicator dial with the number under the pointer of the position indicator at the rear of the receiver (fig. 64). The numbers should be the same. If

the numbers are different, proceed to paragraph 75.

75. Checking Vfo Against Frequency Indicator Dial

Check the vfo against the frequency indicator dial as follows:

a. Turn the KILOCYCLES control to obtain a KILOCYCLES dial reading of 500. The MEGACYCLES dial can be set to any reading.

b. Connect an antenna to a calibrated receiver and bring the antenna near the vfo tube of the receiver under test.

c. Turn the VFO switch of the calibrated receiver to ON and set the BFO PITCH control to 0.

d. Set the calibrated receiver frequency indicator dial to 2.955 kc. Adjust the KILOCYCLES control of the calibrated receiver to obtain a zero beat with the receiver under test.

e. If a zero beat is not obtained with a slight adjustment of the KILOCYCLES control of the calibrated receiver, proceed to paragraph 79.

76. Synchronizing Frequency Indicator Dial with MEGACYCLES and KILOCYCLES Control Shaft Stops

(fig. 56)

Adjust the frequency indicator dial with the control shaft stops as follows:

a. Loosen the clamp on KILOCYCLES frequency indicator dial bevel gear 0338.

b. Turn the KILOCYCLES control clockwise until the stop is reached.

c. Turn the indicator dial drums to KILOCYCLES dial reading of +025. Tighten the clamp on the dial bevel gear.

d. Loosen the clamp on MEGACYCLES frequency indicator dial bevel gear 0337.

e. Turn the MEGACYCLES control counterclockwise until the stop is reached.

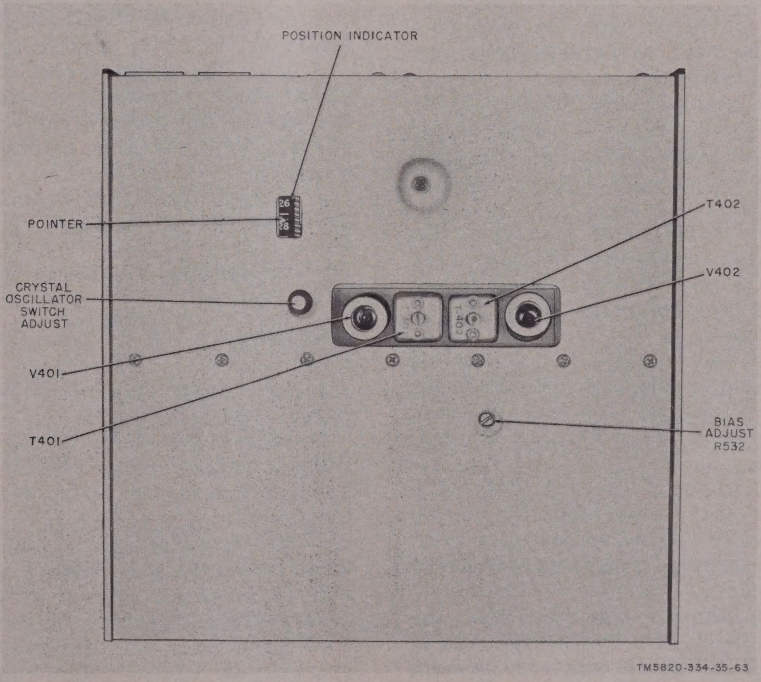


Figure 64. Receiver, rear view, case removed.

f. Turn the indicator dial drums to a MEGACYCLES dial reading of slightly below 00. The tips of the 99 should just start to show. Tighten the clamp on the dial bevel gear.

g. Turn the MEGACYCLES control clockwise until the first detent position is reached (approximately one-fourth turn). The MEGACYCLES dial reading should be exactly 00.

h. If the MEGACYCLES dial does not read exactly 00, loosen the clamp on bevel gear 0327. Turn MEGACYCLES bevel gear 0337 to a MEGACYCLES dial reading of exactly 00. Tighten the clamp on 0327.

77. Synchronizing Camshafts

Adjust the camshafts as follows:

a. Remove the upper deck assembly from the receiver (para 63).

b. Set the MEGACYCLES and KILOCYCLES controls for a frequency indicator reading of 02 000.

c. Loosen clamp A (fig. 59). Rotate the 0.5- to 1.0-mc rf cam until the hole in the rear cam is aligned with the alignment mark on the rear cam guide plate (fig. 65). Tighten clamp A.

d. Loosen clamp B (fig. 59). Rotate the 1.0- to 2.0-mc rf cam until the hole in the rear cam is aligned with the alignment mark on the rear cam guide plate (fig. 65). Tighten clamp B.

e. Loosen clamp C (fig. 59). Rotate the 2.0- to 4.0-mc rf cam until the hole in the rear cam is aligned with the alignment mark on the rear cam guide plate (fig. 65). Tighten clamp C.

f. Loosen clamp D (fig. 59). Rotate the 4.0- to 8.0-mc rf cam until the hole in the rear cam is aligned with the alignment mark on the rear cam guide plate (fig. 65). Tighten clamp D.

g. Loosen clamp E (fig. 59). Rotate the 8.0- to 16.0-mc rf cam until the hole in the rear cam is aligned with the alignment mark on the rear cam guide plate (fig. 65). Tighten clamp E.

h. Loosen clamp F (fig. 59). Rotate the 16.0- to 32.0-mc rf cam until the hole in the rear cam is aligned with the alignment mark on the rear cam guide plate (fig. 65). Tighten clamp F.

i. Loosen clamp G (fig. 59). Rotate the 9- to 18-mc first variable if. cam until the hole in the rear cam is aligned with the alignment mark on the rear cam guide plate (fig. 65). Tighten clamp G.

j. Turn the KILOCYCLES dial fully counterclockwise.

k. Loosen clamp H (fig. 61). Set the small (first variable if.) can rack cam (fig. 60) so that it is almost at the top of its rise. Tighten clamp H. Check the position of the cam when the KILOCYCLES control is at the extreme clockwise position. The cam should be almost at the bottom of its rise.

78. Synchronizing Crystal Oscillator Bandswitch S401 (fig. 57 and 64)

The crystal oscillator bandswitch should be synchronized as follows:

a. Loosen the setscrews on the crystal oscillator Oldham coupler under the rf chassis (fig. 57).

b. Set the MEGACYCLES control to a MEGACYCLES dial reading of 00.

c. Turn the crystal oscillator switch adjust shaft (screwdriver adjustment) at the rear of the crystal unit (fig. 64) and set the drum dial of the position indicator to zero.

d. Tighten the setscrew on the crystal oscillator Oldham coupler (fig. 57).

79. Synchronizing Vfo Tuning Shaft (fig. 53)

Synchronize the vfo tuning shaft as follows:

a. Turn on the receiver and allow it sufficient time to warm up.

b. Loosen the clamp on the side of the Oldham coupler that is closest to the front panel so that the vfo tuning shaft may turn freely.

c. Set the receiver controls for normal voice reception and connect a headset to AUDIO receptacle J101 or J102.

d. With the first two digits of the frequency indicator dial at any setting, slowly rotate the KILOCYCLES control clockwise, starting from its lowest frequency setting, until a rush of background noise

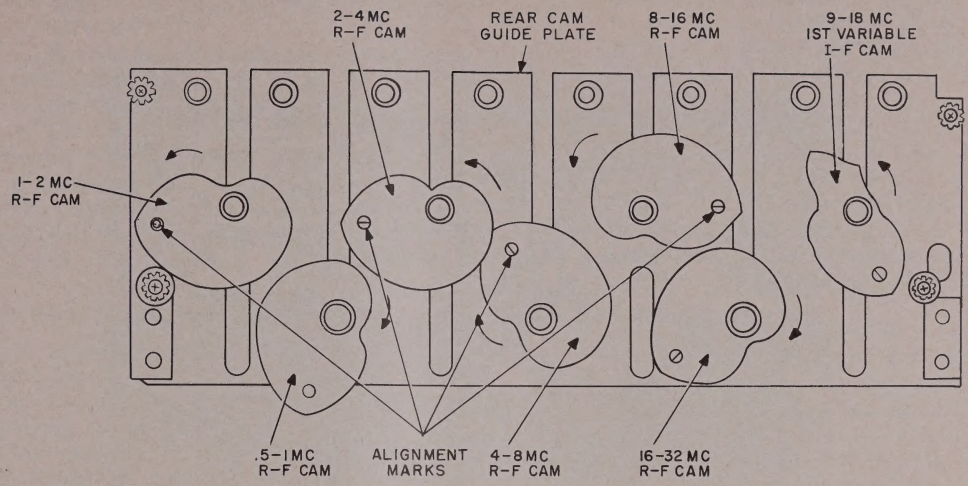


Figure 65. Rf and if. cams, rear view (synchronized at 2 mc).

is heard in the headset. Adjust the KILOCYCLES control for maximum noise.

e. Note the reading of the last three digits on the frequency indicator dial.

f. Turn the AGC switch to CAL, and the BFO switch to ON. Set the BFO PITCH control to 0, and set the frequency indicator dial reading at the nearest 100-kc point to the reading noted in *e* above.

g. Adjust the vfo shaft slightly by hand until a zero beat is obtained. It should not be necessary to turn the vfo shaft more than 1 full turn in either direction to obtain a zero beat.

80. Checking and Synchronizing Six-Position Rf Bandswitch S201 (fig. 66)

Remove the upper deck assembly (para 63) and proceed as follows:

a. Set the MEGACYCLES control to a MEGACYCLES dial reading of 00.

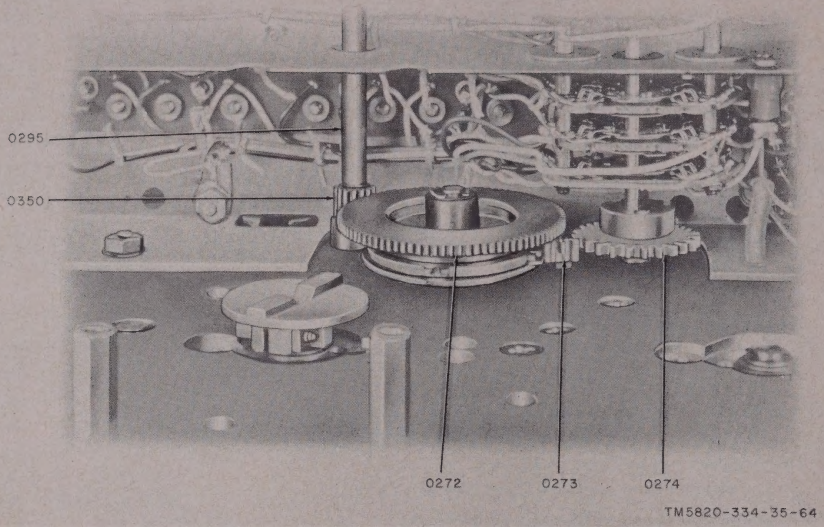
b. Loosen the clamp on gear 0274 on the rf bandswitch shaft and turn the shaft to set the switch contacts so that the 0.5- to 1.0-mc coils are connected into the circuit as indicated by a continuity measurement between E201 and pin 3 of Z201 (fig. 43 and 44).

c. Tighten the clamp on gear 0274 on the rf bandswitch shaft.

d. Turn the MEGACYCLES control through its range. The rf bandswitch should move between 0 and 1, 1 and 2, 3 and 4, 7 and 8, and 15 and 16 mc. If the rf bandswitch does not move between the bands indicated, synchronization of the Geneva system and overtravel coupler (para 81) is necessary.

81. Checking and Synchronizing Geneva System and Overtravel Coupler (fig. 66)

a. Turn the MEGACYCLES control through its range. The rf bandswitch shaft should turn between bands 0 and 1, 1 and 2, 3 and 4, 7 and 8, and 15 and 16 mc.



0272 Geneva system
0273 Gear, spur, 8-tooth
0274 Gear, spur, 24-tooth
0295 Shaft, crystal switch
0350 Gear, spur, 16-tooth

Figure 66. Geneva system and overtravel coupler.

b. If, after checking the synchronization of the frequency indicator (*a* above), the movement of bandswitch shaft 0295 does not take place between the proper bands, proceed as follows with the synchronization of the Geneva system and overtravel coupler:

(1) Turn the MEGACYCLES control counterclockwise until the stop is reached (below 00 mc).
(2) Loosen the clamp for gear 0347 (fig. 62).
(3) Turn shaft 0295 until the Geneva system and overtravel coupler 0272 reaches its stop in the clockwise (0272 viewed from rear of rf subchassis) direction.
(4) Tighten gear clamp 0347 (fig. 62).

c. This adjustment may affect synchronization of crystal oscillator bandswitch S401 and rf bandswitch S201. Check the synchronization of these systems as given in paragraphs 74 and 80.

Section IV. ALIGNMENT

82. Test Equipment and Special Tools Required for Alignment

The following test equipment and special tools are required for alignment of Radio Receiver R-392/URR.

Item	Technical manual
R. F. Signal Generator AN/URM-25	TM 11-5551
Multimeter, Meter ME-26/U	TM 11-6625-200-12
Alignment tool (insulated)	

83. Carrier Level Meter Adjustment

Note. If CARRIER LEVEL meter zero potentiometer R622 is improperly adjusted, serious reduction in gain may result.

a. Disconnect the antenna from the receiver input.

b. Set the AGC switch to ON.

c. Set the RF GAIN SQUELCH THRESH control fully clockwise.

d. Adjust meter zero potentiometer R622 (fig. 35) on the lower deck assembly to obtain a zero reading on the CARRIER LEVEL meter.

84. Alignment of 455-Kc If. Stages

a. Allow at least a 5-minute warmup time for the receiver and the AN/URM-25.

b. Connect the AN/URM-25 output lead through a 0.05-uf capacitor to J510 or pin 5 of vfo-mixer V801 (fig. 41). Set the AN/URM-25 modulation control for unmodulated output. To avoid removing a subchassis when a voltage is to be measured or when a signal is to be injected at a tube socket pin that does not have a test point, remove the tube, wrap 1 turn of a short, thin, insulated wire, with both ends bared, around the desired pin, and replace the tube. Connection for measurement or signal injection can then be made through the exposed end of the wire.

c. Connect the ME-26/U to test jack J615 (fig. 35). The voltage measured is developed across diode-load resistor R605 and is negative with respect to ground.

d. Make the following settings on the R-392/URR:

(1) BAND WIDTH switch to 2 KC.
(2) RF GAIN SQUELCH THRESH control fully clockwise.
(3) BFO switch to OFF.
(4) Function switch to NORMAL.
(5) AGC switch to OFF.

e. Set the AN/URM-25 frequency to 455 kc and advance its signal output until an indication is obtained on the ME-26/U. Perform the adjustments described in *f* below. If no indication is obtained, perform the following steps to obtain an approximate alignment before proceeding:

(1) Set the AN/URM-25 to 455 kc at maximum output. Turn the BAND WIDTH switch to 8 KC. If output is not yet obtained, perform the procedure outlined in (2) below. If output indication is obtained, adjust the slugs of transformers T505, T504, T503, T502, and T501 (fig. 39), in that order, for a peak indication on the ME-26/U. Set the BAND WIDTH switch to 4 KC, and readjust the slugs for peak output. Repeat the adjustments with the BAND WIDTH switch at 2 KC. After completing the adjustments, perform the procedure described in *f* below.

(2) The following procedure is required when the slugs have been displaced too far from their normal positions within the transformers.
   (a) Set the BAND WIDTH switch at 2 KC and the AN/URM-25 to 455 kc. Connect the AN/URM-25 output to pin 1 of tube V505. Adjust the slugs of transformer T505 for peak output.
   (b) Apply the 455-kc signal to pin 1 of tube V504, and adjust the slugs of transformer T504 for peak output.
   (c) Apply the procedure described in (*a*) and (*b*) above to remaining tubes and transformers, in the following order: tube V503, transformer T503; tube V502, transformer T502; tube V501, transformer T501. Proceed with the next step in *f* below.

f. During alignment, continually adjust the attenuator of the AN/URM-25 to maintain the indication on the ME-26/U below 3 volts. Connect the AN/URM-25 to pin 5 of V801 and adjust the slugs of transformers T601 (fig. 35), T505, T504, T503, and T502 (fig. 39), in that order, for peak indication on the ME-26/U. Repeat these adjustments until no further increase in output is noticeable on the ME-26/U.

g. Turn the BAND WIDTH switch from 2 KC to 8 KC. Adjust the slugs of transformer T501 for a peak indication on the ME-26/U. Repeat the adjustment of these slugs until no further increase is noted.

h. Connect the AN/URM-25 to receptacle J510. Adjust the AN/URM-25 output for between 75 and 100 microvolts (unmodulated).

i. Set bias adjust R532 (cathode of fifth if. amplifier V505) (fig. 64) for a maximum indication on the ME-26/U. Adjust variable resistor R521 (fig. 40) for an indication of approximately 2.5 volts on the ME-26/U.

j. Repeat procedures in *f* and *g* above.

k. Adjust the AN/URM-25 output for 300 microvolts (unmodulated). Set the AGC switch at ON. Adjust capacitor C634 (fig. 36) for a peak indication on the CARRIER LEVEL meter.

Note. Remove the lower deck assembly (para 62) to adjust C634 and R521.

85. Alignment of Second Crystal Oscillator (fig. 47 and 64)

a. Connect the ME-26/U to test jack J615 (fig. 35). The voltage measured is negative with respect to ground.

b. Set the controls on the receiver as follows:

(1) BAND WIDTH switch to 2 KC.
(2) RF GAIN SQUELCH THRESH control fully clockwise.
(3) BFO switch to OFF.
(4) Function switch to NORMAL.
(5) AGC switch to OFF.

c. Adjust the AN/URM-25 to provide an unmodulated signal at 31,500 kc. Set the receiver to 31,500 kc. Adjust the KILOCYCLES control slightly for a peak indication on the ME-26/U. If the crystal oscillator is to be aligned on all bands, set trimmer capacitor C435 for one-half capacitance (screw slot pointing toward the rear of the receiver) and adjust the slug of transformer T402 for a peak indication on the ME-26/U.

d. Align the trimmer capacitors for the other bands as shown in the chart in (3) below.

(1) Set the AN/URM-25 and receiver to the frequency given in the left-hand column.
(2) Adjust the KILOCYCLES control slightly for a peak indication on the ME-26/U.
(3) Adjust the trimmer capacitors listed in the right-hand column for a peak indication on the ME-26/U.

Frequency (kc)	Adjust trimmer (fig. 65) for maximum indication on ME-26/U
30,500	C436
29,500	C437
28,500	C438
27,500	C439
26,500	C440
25,500	C441
24,500	C442
23,500	C444
22,500	C446
21,500	C448
20,500	C450
19,500	C452
18,500	C454
17,500	C424
16,500	C456
15,500	C422
14,500	C432
13,500	C430
12,500	C418
11,500	C420
10,500	C428
9,500	C416
8,500	C426

86. Alignment of First Crystal Oscillator (fig. 47 and 64)

a. Connect the ME-26/U to test jack J615 (fig. 35). The voltage measured is negative with respect to ground.

b. Set the controls on the receiver as follows:

(1) BAND WIDTH switch to 2 KC.
(2) RF GAIN SQUELCH THRESH control fully clockwise.
(3) BFO switch to OFF.
(4) Function switch to NORMAL.
(5) AGC switch to OFF.

c. Adjust the AN/URM-25 to provide an unmodulated signal at 3,500 kc. Set the receiver to 3,500 kc. Adjust the KILOCYCLES control slightly for a peak indication on the ME-26/U. If the crystal oscillator is to be aligned on all bands, set trimmer capacitor C406 for one-half capacitance (screw slot pointing toward the rear of the receiver) and adjust the slug in transformer T401 for a peak indication on the ME-26/U.

d. Align the trimmer capacitors for the

other bands as shown in the chart in (3) below.

(1) Set the AN/URM-25 and receiver to the frequency given in the left-hand column.
(2) Adjust the KILOCYCLES control slightly for a peak indication on the ME-26/U.
(3) Adjust the trimmer capacitors listed in the right-hand column for a peak indication on the ME-26/U.

Frequency	Adjust trimmer (fig. 65) for maximum indication on ME-26/U
7,500	C412
6,500	C410
5,500	C404
4,500	C408

87. Alignment of Second Variable If. Amplifier

a. Connect the ME-26/U between test jack J615 and ground (fig. 35).

b. Make the following settings on the R-392/URR:

(1) BAND WIDTH switch to 2 KC.
(2) RF GAIN SQUELCH THRESH control fully clockwise.
(3) BFO switch to OFF.
(4) Function switch to NORMAL.
(5) AGC switch to OFF.

c. Connect the AN/URM-25 through a 0.05-uf capacitor to the control grid (pin 1) of second mixer V204 (fig. 43). Set the AN/URM-25 modulation control for unmodulated output.

d. Set the MEGACYCLES control to a MEGACYCLES dial reading of 01.

e. Set the KILOCYCLES control to a KILOCYCLES dial reading of 100.

f. Set the AN/URM-25 to 2.9 mc.

g. Adjust trimmer capacitors C281, C284, and C287 (fig. 67) for a peak indication on the ME-26/U. Adjust the attenuator on the AN/URM-25 to maintain the ME-26/U indication at less than 3 volts.

h. Set the KILOCYCLES control to a KILOCYCLES dial reading of 900.

i. Set the AN/URM-25 to 2.1 mc.

j. Adjust the slugs of L224, L225, and L226 (fig. 67) for a peak indication on the ME-26/U.

k. Repeat the procedure in *d* through *j* above until no further increase can be obtained on the ME-26/U.

88. Alignment of First Variable If. Amplifier

a. Connect the ME-26/U to test jack J615 (fig. 35) and make the following settings on the R-392/URR:

(1) BAND WIDTH switch to 2 KC.
(2) RF GAIN SQUELCH THRESH control fully clockwise.
(3) BFO switch to OFF.
(4) Function switch to NORMAL.
(5) AGC switch to OFF.

b. Connect the AN/URM-25 through a 0.05-uf capacitor to the control grid (pin 1) of first mixer V203 (fig. 43).

c. Set the KILOCYCLES control for a KILOCYCLES dial reading of 500. Do not change this setting during the alignment procedure.

d. Set the MEGACYCLES control for a MEGACYCLES dial reading of 01.

e. Set the AN/URM-25 to 9.5 mc. Throughout this procedure, adjust the AN/URM-25 attenuator to maintain an indication of less than 3 volts on the ME-26/U.

f. Adjust the slugs of coils L221, L222, and L223 (fig. 67) for a peak indication on the ME-26/U.

g. Set the MEGACYCLES dial reading to 07.

h. Set the AN/URM-25 to 17.5 mc.

i. Adjust trimmer capacitors C270, C273, and C276 (fig. 67) for a peak indication on the ME-26/U.

j. Repeat the procedures in *d* through *i* above, until no further increase can be obtained on the ME-26/U.

89. Alignment of Rf Stages

a. Connect the ME-26/U between test jack J615 and ground (fig. 35).

b. Make the following settings on the R-392/URR:

(1) BAND WIDTH switch to 2 KC.
(2) RF GAIN SQUELCH THRESH control fully clockwise.
(3) BFO switch to OFF.
(4) Function switch to NORMAL.

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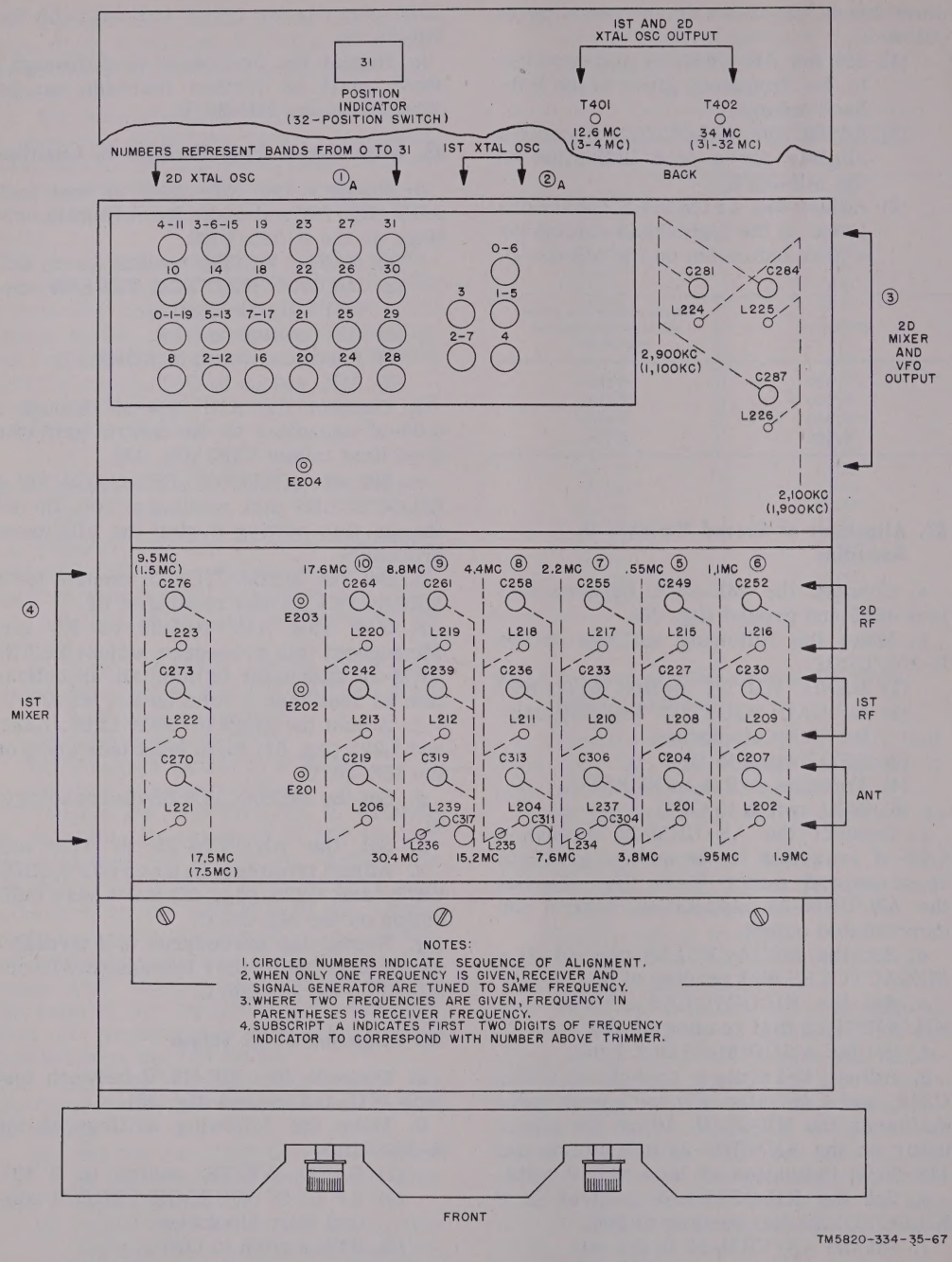

Figure 67. Receiver upper deck, alignment points.

(5) AGC switch to OFF.

(6) ANT TRIM control to 0.

c. Connect the AN/URM-25 through a 50-uuf capacitor to points in the order listed in column 7 of the chart in *i* below.

d. Set the MEGACYCLES and KILOCYCLES controls to indicate (on the frequency indicator) the digits in columns 2 and 3, respectively.

e. Set the AN/URM-25 to the frequency listed in column 4. To obtain the exact required frequency, adjust the AN/URM-25 tuning control for a peak indication on the ME-26/U. Do not depend upon the calibration of the AN/URM-25.

f. During the procedure, adjust the AN/URM-25 attenuator to maintain an indication of less than 3 volts on the ME-26/U.

g. Refer to figure 67 for location of rf adjustment screws. Adjust the slugs for a set of tuned circuits while the receiver is tuned to the lower frequency indicated in the chart for that set of tuned circuits. Adjust the trimmer capacitors while the receiver is tuned to the higher frequency. Adjust the slugs of a set of tuned circuits listed in column 5 to obtain a peak indication on the ME-26/U. After changing the frequency settings of the receiver and the AN/URM-25, adjust the trimmer capacitors of a set of tuned circuits listed in column 6 to obtain a peak indication on the ME-26/U. The trimmer capacitors are accessible through holes in the top of the shield cans; they are adjusted by using the insulated alignment tool.

h. Repeat adjustments for each set of rf coils until no further change is noticeable on the ME-26/U.

i. The alignment of rf stages is shown in the chart below.

Rf stage alignment

1	2	3	4	5	6	7
Set of rf coils	MEGACYCLES control setting	KILOCYCLES control setting	Signal generator frequency (tune for peak output) kc	Adjust slugs for peak output.	Adjust trimmer capacitors for peak output	Signal generator connection (preliminary alignment only)
0.5-1 mc	00	550	550	L215 L208 L201		Pin 1, V202; pin 1, V201; ANT post E101
	00	950	950		C249 C227 C204	Pin 1, V202; pin 1, V201; ANT post E101
1-2 mc	01	100	1,100	L216 L209 L202		Pin 1, V202; pin 1, V201; ANT post E101
	01	900	1,900		C252 C230 C207	Pin 1, V201; pin 1, V201; ANT post E101
2-4 mc	02	200	2,200	L217 L210 L234 L237		Pin 1, V202; pin 1, V201; ANT post E101
	03	800	3,800		C255 C233 C304 C306	Pin 1, V202; pin 1, V201; ANT post E101
4-8 mc	04	400	4,400	L218 L211 L235 L238		Pin 1, V202; pin 1, V201; ANT post E101
	07	600	7,600		C258 C236 C311 C313	Pin 1, V202; pin 1, V201; ANT post E101

Rf stage alignment

1	2	3	4	5	6	7
Set of rf coils	MEGACYCLES control setting	KILOCYCLES control setting	Signal generator frequency (tune for peak output) kc	Adjust slugs for peak output.	Adjust trimmer capacitors for peak output	Signal generator connection (preliminary alignment only)
8-16 mc	08	800	8,800	L219 L212 L236 L239		Pin 1, V202; pin 1, V201; ANT post E101
	15	200	15,200		C261 C239 C317 C319	Pin 1, V202; pin 1, V201; ANT post E101
16-32 mc	17	600	17,600	L220 L213 L206		Pin 1, V202; pin 1, V201; ANT post E101
	30	400	30,400		C264 C242 C219	Pin 1, V202; pin 1, V201; ANT post E101

90. Calibration of Bfo

a. Connect a headset to an AUDIO receptacle on the R-392/URR.

b. Set the AGC switch to ON.

c. Set the MEGACYCLES and KILOCYCLES controls to receive an unmodulated signal from a station or from the AN/URM-25.

d. Adjust the KILOCYCLES and ANT TRIM controls for a peak indication on the CARRIER LEVEL meter.

e. Set the BAND WIDTH switch to 2 KC.

f. Turn the BFO switch to ON.

g. Set the BFO PITCH control to 0.

h. If a zero beat is obtained when the BFO PITCH control is on or close to 0 (within one-half division), alignment of the bfo is not required. If a zero beat is not obtained within one-half division of 0 on the BFO PITCH control, proceed with the alignment as follows:

(1) Remove the lower deck assembly from the receiver (para 62). Connect plugs P113 to J613, P810 to J510, P112 to J612, and P111 to J611 (fig. 53). *Do not use extension cables.*

(2) Tune the receiver as described in *b* through *g* above.

(3) Adjust the slug of T602 (fig. 40) to obtain a zero beat with the BFO PITCH control at 0.

(4) Reassemble the lower deck assembly (para 62).

91. Adjustment of Calibration Oscillator

a. Connect a headset to an AUDIO receptacle on the R-392/URR.

b. Make the following settings on the R-392/URR:

(1) Function switch to NORMAL.

(2) AGC switch to ON.

(3) RF GAIN THRESH SQUELCH control fully clockwise.

(4) AF GAIN control fully clockwise.

(5) BAND WIDTH switch to 2 KC.

(6) BFO switch to ON and BFO PITCH to 0.

c. Unlock the KILOCYCLES control Tune in station WWV at 5, or 10 mc, whichever is stronger.

d. Adjust ANT TRIM control for maximum indication on the CARRIER LEVEL meter.

e. Adjust the KILOCYCLES control for a zero beat. Make this adjustment when WWV is unmodulated to avoid a zero beat with a sideband.

f. If the last three digits on the frequency indicator dial are not exactly 000, turn the DIAL ZERO control completely clockwise and adjust the KILOCYCLES control for an exact 000.

g. Set the AGC switch to CAL. No beat note should be heard. If a beat note is heard, adjust trimmer capacitor C706 (fig. 50) for a zero beat. *Do not turn the BFO PITCH control during this adjustment.*

CHAPTER 4
FOURTH ECHELON TESTING PROCEDURES

92. General

a. Testing procedures are prepared for use by Signal Field Maintenance Shops and Signal Service Organizations responsible for fourth echelon maintenance to determine the acceptability of repaired signal equipment. These procedures prescribe specific requirements that repaired signal equipment *must* meet before it is returned to the using organization. The procedures may also be used as a guide for testing equipment repaired at third echelon if the proper tools and test equipment are available. A summary of the performance standards is given in paragraph 103.

b. Each test depends on the preceding one for certain operating procedures and where applicable, for test equipment calibrations. Comply with the instructions preceding the chart before proceeding to the chart. Perform each test in sequence. *Do not vary the sequence.* For each step, perform all actions required in the *Test equipment control settings* and *Radio Receiver R-392/URR control settings* columns; then perform each specific test procedure and verify it against its performance standard.

93. Test Equipment, Materials, and Other Equipment Required

All test equipment, materials, and other equipment required to perform the tests given in this section are listed in the following charts and are authorized under TA 11-17 and TA 11-100(11-17) except as noted. Specific models of equipment are used to perform the test procedures given in paragraphs 95 through 101. If these test procedures are performed with other models of equipment, an allowance must be made for any test connection or test results that may differ from those given in these test procedures.

a. Test Equipment.

Nomenclature	Federal stock No.	Technical manual
RF Signal Generator AN/URM-25F.	6625-570-5719	TM 11-5551E
Output Meter TS-585B/U.	6625-244-0501	TM 11-5017
Electronic Multimeter TS-505A/U.	6625-243-0562	TM 11-5511
Audio Oscillator TS-382 (*)/U[a].	6625-192-5094	TM 11-2684A
Spectrum Analyzer TS-723A/U.	6625-668-9418	TM 11-5097
Electronic Equipment Maintenance Kit MK-288/URM.	6625-557-5716	TB SIG 319
Electronic Voltmeter ME-30(*)/U[b].	6625-669-0742	TM 11-5132
Electromagnetic Shielding Enclosure MX-1761/G (or equivalent).	4940-542-0002	None

[a] Indicates TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U and TS-382F/U.
[b] Indicates ME-30A/U and ME-30B/U.

b. Materials and Other Equipment.

Nomenclature	Federal stock No.	Technical reference
Dynamic Loudspeaker LS-166/U.	5965-243-6420	None
Headset HS-30		
Power Supply PP-1097A/U.	6130-669-6640	TM 11-5111
or		
Power Supply PP-1104A/U.	6130-542-6385	TM 11-5126
Electrical Special Purpose Power Cable Assembly CX-1597/U[a] (power cable).	5935-511-6537	None
or both		
Electrical plug connector[b].	5935-511-6537	None
and		
Electrical Power Cable WD-10/U[c].	6145-284-0087	TA 11-100 (11-17)
Telephone Plug PJ-055B.	5935-192-4760	None
Electrical wire (hookup wire 12")[d].	6145-160-5291	None

[a] Used to connect Radio Receiver R-392/URR to a power source but not authorized under TA 11-100(11-17).
[b] Repair part item for Radio Set AN/GRC-19 authorized stockage at third through fifth echelon. Required to fabricate power cable if Electrical Special Purpose Power Cable Assembly CX-1597/U is not available.
[c] Required to fabricate power cable if Electrical Special Purpose Power Cable Assembly CX-1597/U in not available.
[d] Any insulated, stranded, copper conductor, hookup wire; # 20 AWG is suitable.

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94. Special Test Facilities

a. Because of the sensitivity of the receiver and its construction, the electrical tests (except the operational tests (para 102)) should be conducted in a well-shielded room. Electromagnetic Shielding Enclosure MX-1761/G, listed in the chart in paragraph 93*a*, or its equivalent, is suitable.

b. A primary source of dc power capable of supplying 3 amperes at 28 volts is required to power the receiver for the tests. The power source output voltage must be free from any fluctuations or interference; therefore, no other equipment should be operated from the power source used to power the receiver during the tests. Either of the power supplies listed in the chart in paragraph 93*b* or any other available source of power meeting the requirements may be used.

c. A special-purpose cable assembly is required to connect Radio Receiver R-392/URR to a power source. Electrical Special Purpose Cable Assembly CX-1597/U, designed for this purpose, may be used if available, or a suitable cable assembly may be fabricated by use of the connector and electrical power cable (or equivalent) listed in the chart in paragraph 93*b*. A wiring diagram of the power cable assembly is given in figure 68.

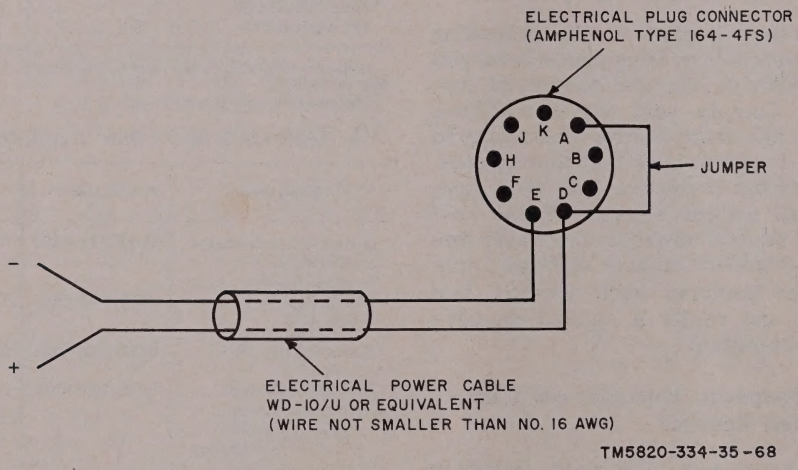

Figure 68. Power cable assembly wiring diagram.

95. Physical Tests and Inspection

a. Test Equipment and Materials. None.
b. Test Connections and Conditions. The receiver must be removed from its case for this and all subsequent tests.
c. Procedure.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedure	Performance standard
1	None.	Controls may be in any position.	*a.* Inspect the receiver for loose and missing parts, physical damage, and condition of finish. *Note.* Touchup painting is recommended in lieu of refinishing whenever practicable. Screwheads, receptacles, and other plated parts will not be painted or polished with abrasives. *b.* Inspect all connectors, plugs, and receptacles for looseness and damage. *c.* Remove the fuseholder caps; inspect the fuseholders for damage and the fuses for correct type and rating. *Note.* Replace the fuseholder caps before proceeding.	*a.* No loose or missing parts or physical damage evident. All surfaces intended to be painted do not show bare metal. Panel lettering legible. *b.* All plugs and connectors are tight. All receptacles are tight and free from damage. *c.* The fuseholders are in serviceable condition. Each fuseholder contains a good fuse of the proper type and rating, as indicated on the panel above the fuseholder.
2	None.	Set controls as indicated in *Test procedure* column.	*a.* Turn the MEGACYCLES control fully counterclockwise; note the action of the mechanism and the final indication on the MEGACYCLES dial. *b.* Turn the MEGACYCLES control fully clockwise; note the action of the mechanism and	*a.* The control turns freely without binding or excessive looseness. The detent function is positive and synchronized with the dial. The MEGACYCLES dial indicates halfway between 00 and 99, with the control at the counterclockwise stop. *b.* The control turns freely without binding or excessive looseness. The detent function is positive and synchro-

94. Special Test Facilities

a. Because of the sensitivity of the receiver and its construction, the electrical tests (except the operational tests (para 102)) should be conducted in a well-shielded room. Electromagnetic Shielding Enclosure MX-1761/G, listed in the chart in paragraph 93*a*, or its equivalent, is suitable.

b. A primary source of dc power capable of supplying 3 amperes at 28 volts is required to power the receiver for the tests. The power source output voltage must be free from any fluctuations or interference; therefore, no other equipment should be operated from the power source used to power the receiver during the tests. Either of the power supplies listed in the chart in paragraph 93*b* or any other available source of power meeting the requirements may be used.

c. A special-purpose cable assembly is required to connect Radio Receiver R-392/URR to a power source. Electrical Special Purpose Cable Assembly CX-1597/U, designed for this purpose, may be used if available, or a suitable cable assembly may be fabricated by use of the connector and electrical power cable (or equivalent) listed in the chart in paragraph 93*b*. A wiring diagram of the power cable assembly is given in figure 68.

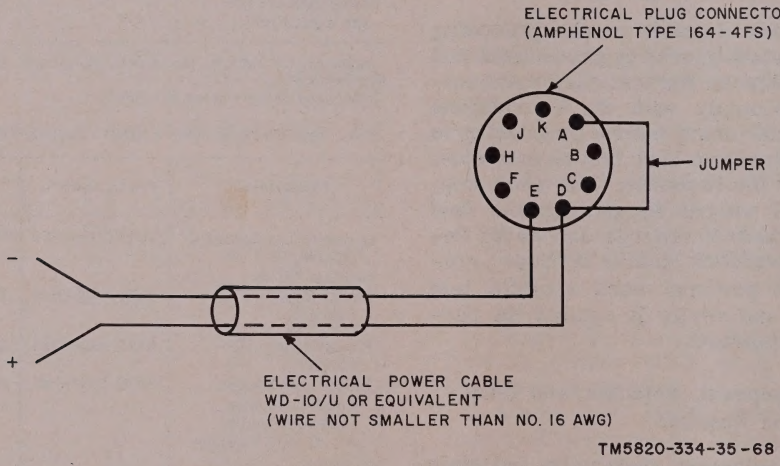

Figure 68. Power cable assembly wiring diagram.

95. Physical Tests and Inspection

a. *Test Equipment and Materials.* None.
b. *Test Connections and Conditions.* The receiver must be removed from its case for this and all subsequent tests.
c. *Procedure.*

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedure	Performance standard
1	None.	Controls may be in any position.	a. Inspect the receiver for loose and missing parts, physical damage, and condition of finish. *Note.* Touchup painting is recommended in lieu of refinishing whenever practicable. Screwheads, receptacles, and other plated parts will not be painted or polished with abrasives. b. Inspect all connectors, plugs, and receptacles for looseness and damage. c. Remove the fuseholder caps; inspect the fuseholders for damage and the fuses for correct type and rating. *Note.* Replace the fuseholder caps before proceeding.	a. No loose or missing parts or physical damage evident. All surfaces intended to be painted do not show bare metal. Panel lettering legible. b. All plugs and connectors are tight. All receptacles are tight and free from damage. c. The fuseholders are in serviceable condition. Each fuseholder contains a good fuse of the proper type and rating, as indicated on the panel above the fuseholder.
2	None.	Set controls as indicated in *Test procedure* column.	a. Turn the MEGACYCLES control fully counterclockwise; note the action of the mechanism and the final indication on the MEGACYCLES dial. b. Turn the MEGACYCLES control fully clockwise; note the action of the mechanism and the final indication on the MEGACYCLES dial. c. Turn the DIAL LOCK control counterclockwise. d. Turn the DIAL LOCK control fully counterclockwise. e. Turn the KILOCYCLES control fully clockwise; note the KILOCYCLES dial indication. f. Turn the KILOCYCLES control fully counterclockwise; note the KILOCYCLES dial indication. g. Turn each of the following front panel controls throughout their limits of travel: (1) AF GAIN. (2) BFO PITCH. (3) RF GAIN SQUELCH THRESH. (4) ANT TRIM. h. Turn each of the following front panel switches to each of their indicated positions: (1) DIAL DIM. (2) BAND WIDTH. (3) Function switch. (4) BFO. (5) AGC. i. Turn the DIAL LOCK control fully clockwise (fingertight); then attempt to turn the KILOCYCLES control. ***Caution:* Do not exert undue force in attempting to turn the KILOCYCLES control.** *Note.* Turn the DIAL LOCK control fully counterclockwise before proceeding j. Note the indication on the CARRIER LEVEL meter.	a. The control turns freely without binding or excessive looseness. The detent function is positive and synchronized with the dial. The MEGACYCLES dial indicates halfway between 00 and 99, with the control at the counterclockwise stop. b. The control turns freely without binding or excessive looseness. The detent function is positive and synchronized with the dial. The MEGACYCLES dial indicates halfway between 31 and 32, with the control at the clockwise stop. c. The DIAL LOCK control turns freely without binding or excessive looseness. d. The DIAL ZERO control turns freely without binding or excessive looseness. e. The control turns freely without binding or excessive looseness. The KILOCYCLES dial indicates between +015 and +035 (note plus sign). f. The control turns freely without binding or excessive looseness. The KILOCYCLES dial indicates between -985 and -965 (note minus sign). g. The controls turn freely without binding or excessive looseness. Knobs are tight on their shafts and properly indexed. h. The switches operate freely without binding or excessive looseness. The detent function is positive. Knobs are tight on their shafts and properly indexed. i. The KILOCYCLES control is firmly locked. j. The pointer of the CARRIER LEVEL meter lies directly over the 0 line on the left edge of the meter scale.

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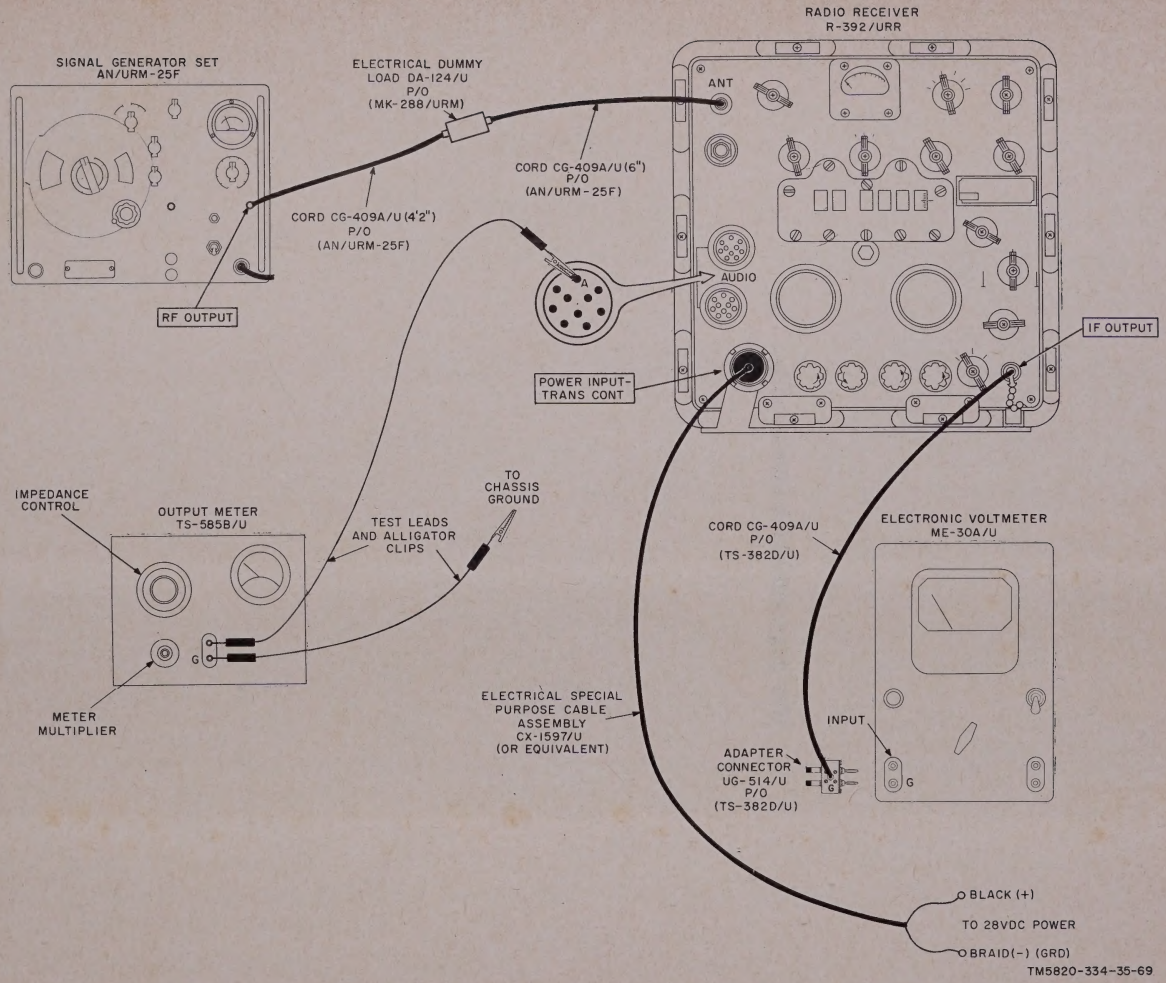

Figure 69. Sensitivity test.

96. Sensitivity Test
(fig. 69)

a. Test Equipment and Materials.
RF Signal Generator AN/URM-25F.
Output Meter TS-585B/U.

6	*AN/URM-25F:* BAND SWITCH: 1.5-3.8. TUNING: 2.0 MEGACYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U:* Same as step 1.	MEGACYCLES: 02. KILOCYCLES: 000. BAND WIDTH: 8 KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.		
7	*AN/URM-25F:* BAND SWITCH: 1.5-3.8. *TS-585B/U:* Same as step 1.	MEGACYCLES: 03. KILOCYCLES: 000. clockwise. AF GAIN: midposition.	Repeat test procedures in step 1*a* through *h*.	The AN/URM-25F panel watt.
12	*AN-URM-25F:* BAND SWITCH: 10-25. TUNING: 17 MEGACYCLES. ATTENUATOR: 3. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U:* Same as step 1.	MEGACYCLES: 17. KILOCYCLES: 000. BAND WIDTH: 4 KC. BFO: ON. BFO PITCH: 0. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	*a.* Repeat test procedures in step 10*a* through *d*. *b.* Adjust the AN/URM-25F MICROVOLTS control for an indication of 2 on the panel meter (1-3 MICROVOLTS scale). *c.* Adjust the receiver AF GAIN control for an indication of 10 milliwatts on the TS-585B/U. *d.* Set the receiver KILOCYCLES dial to 020 and note the indication on the TS-585B/U.	*a.* None. *b.* None. *c.* None. *d.* The TS-585B/U indicates not more than 1 milliwatt.
13	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: 1.5 MEGACYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *ME-30A/U:* Range selector switch: .1. *Note.* TS-585B/U not required for this step.	MEGACYCLES: 01. KILOCYCLES: 500. BAND WIDTH: 4 KC. BFO: OFF. AGC: ON. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: fully counterclockwise.	*a.* Connect ME-30A/U to the receiver as shown in figure 69. *b.* Adjust the AN/URM-25F SET RF OUTPUT control for a full-scale (10) indication on the MICROVOLTS scale of the panel meter. *c.* Adjust the AN/URM-25F TUNING control (in the vicinity of 1.5 mc) for a peak indication on the ME-30A/U. *d.* Adjust the receiver ANT TRIM control for a peak indication on the ME-30A/U and note this indication.	*a.* None. *b.* None. *c.* None. The ME-30A/U indicates not less than 24 millivolts (.24 on the 0-1.0 R.M.S. VOLTS scale).

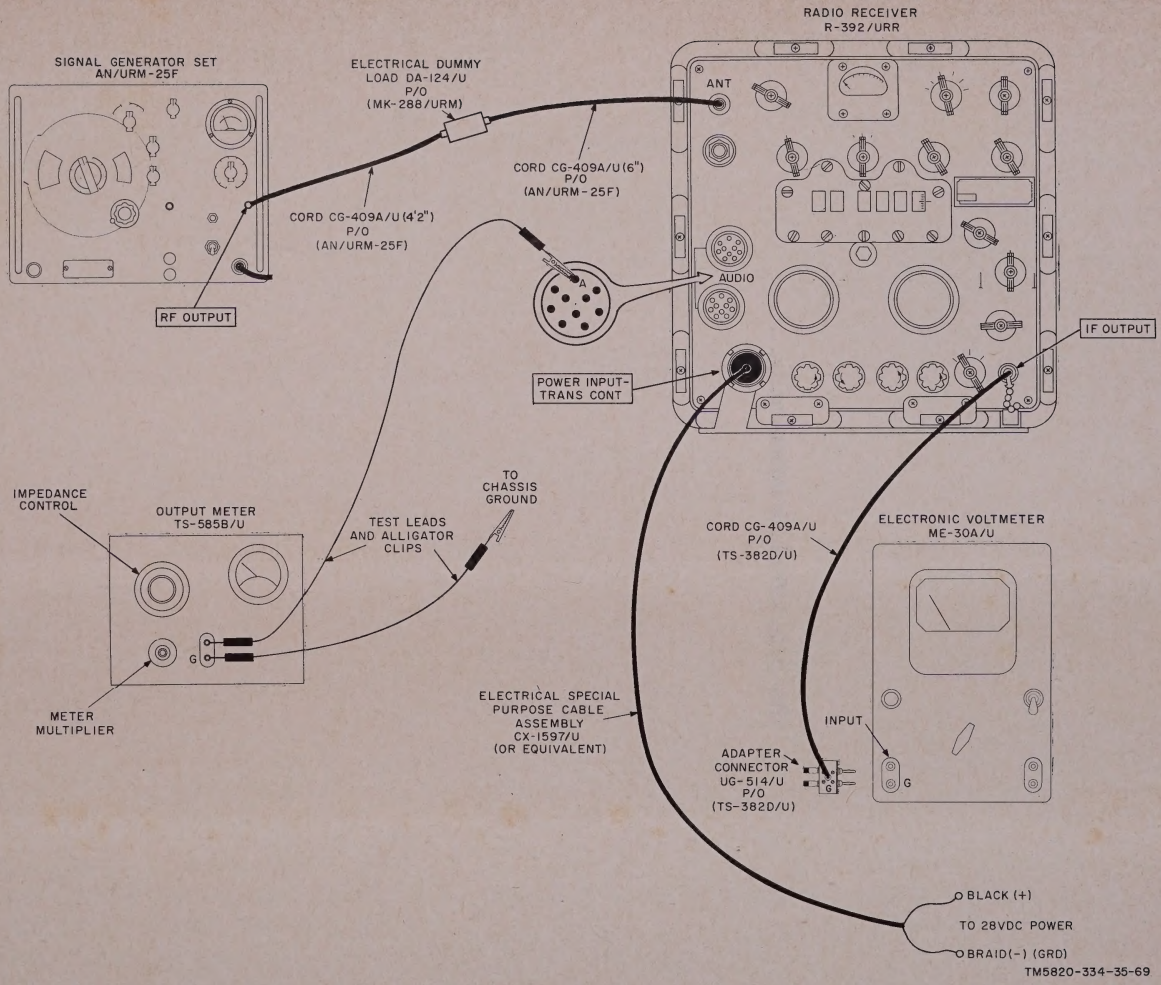

Figure 69. Sensitivity test.

96. Sensitivity Test
(fig. 69)

a. Test Equipment and Materials.
RF Signal Generator AN/URM-25F.
Output Meter TS-585B/U.
Electronic Voltmeter ME-30(*)/U.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.
Test leads, 2 each.
Alligator clips, 2 each.

b. Test Connections and Conditions. Except for Electronic Voltmeter ME-30A/U, connect the equipment as shown in figure 69. Do not connect Electronic Voltmeter ME-30A/U until instructed to do so in the test procedures of step No. 13.

c. Procedure.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedure	Performance standard
1	*AN/URM-25F:* BAND SWITCH: 220-600. TUNING: 500 KILO-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U:* Impedance control: 60(X10 bracket). Meter multiplier: 1.	DIAL LOCK: fully counterclockwise. DIAL ZERO: fully counterclockwise. MEGACYCLES: 00. KILOCYCLES: 500. BAND WIDTH: 8 KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	*a.* Make the following preliminary adjustments of the AN/URM-25F: (1) Adjust the SET RF OUTPUT control for a full-scale (10) indication on the MICROVOLTS scale of the panel meter. (2) Set the FUNCTION SWITCH to 400. (3) Adjust the % MOD AUDIO OUT LEVEL control for an indication of 30 on the panel meter (% MOD scale). *b.* Adjust the AN/URM-25F TUNING control for a peak indication on the TS-585B/U. *c.* Adjust the receiver ANT TRIM control for a peak indication on the TS-585B/U. *d.* Set the AN/URM-25F FUNCTION SWITCH to CW. *e.* Adjust the receiver AF GAIN control for an indication of 1 milliwatt on the TS-585B/U. *f.* Set the AN/URM-25F FUNCTION SWITCH to 400 and adjust the MICROVOLTS control for an indication of 10 milliwatts on the TS-585B/U. *g.* Repeat *d* through *f* above until no further adjustments are necessary. *h.* Set the AN/URM-25F FUNCTION SWITCH to CW and note the indication on the panel meter (MICROVOLTS, 0-10 scale).	*a.* None. *b.* None. *c.* None. *d.* None. *e.* None. *f.* None. *g.* None. *h.* The AN/URM-25F panel meter indicates not more than 9 microvolts.
2	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: .75 MEGA-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U:* Same as step 1.	MEGACYCLES: 00. KILOCYCLES: 750. BAND WIDTH: 8KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	Repeat test procedures in step 1*a* through *h*.	Same as step 1.
3	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: .99 MEGA-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U:* Same as step 1.	MEGACYCLES: 00. KILOCYCLES: 990. BAND WIDTH: 8KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	Repeat test procedures in step 1*a* through *h*.	Same as step 1.
4	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: 1.0 MEGA-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON.	MEGACYCLES: 01. KILOCYCLES: 000. BAND WIDTH: 8 KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	Repeat test procedures in step 1*a* through *h*.	The AN/URM-25F panel meter indicates not more than 7 microvolts.
5	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: 1.5 MEGA-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U.* Same as step 1.	MEGACYCLES: 01. KILOCYCLES: 500. BAND WIDTH: 8 KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	Repeat test procedures in step No. 1*a* through *h*.	Same as step 4.
6	*AN/URM-25F:* BAND SWITCH: 1.5-3.8. TUNING: 2.0 MEGA-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U:* Same as step 1.	MEGACYCLES: 02. KILOCYCLES: 000. BAND WIDTH: 8 KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.		
7	*AN/URM-25F:* BAND SWITCH: 1.5-3.8. TUNING: 3.0 MEGA-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U:* Same as step 1.	MEGACYCLES: 03. KILOCYCLES: 000. BAND WIDTH: 8 KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AG GAIN: midposition.	Repeat test procedures in step 1*a* through *h*.	The AN/URM-25F panel meter indicates not more than 9 microvolts.
8	*AN/URM-25F:* BAND SWITCH: 10-25. TUNING: 17 MEGA-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U:* Same as step 1.	MEGACYCLES: 17. KILOCYCLES: 000. BAND WIDTH: 8 KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	Repeat test procedures in step 1*a* through *h*.	The AN/URM-25F panel meter indicates not more than 5 microvolts.
9	*AN/URM-25F:* BAND SWITCH: 25-50. TUNING: 31 MEGA-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U:* Same as step 1.	MEGACYCLES: 31. KILOCYCLES: 000. BAND WIDTH: 8 KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	Repeat test procedures in step 1*a* through *h*.	Same as step 8.
10	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: .75 MEGA-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U:* Same as step 1.	MEGACYCLES: 00 KILOCYCLES: 750. BAND WIDTH: 4 KC. BFO: ON. BFO PITCH: 0. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise AF GAIN: midposition.	*a.* Adjust the AN/URM-25F SET RF OUTPUT control for a full-scale (10) indication on the panel meter. *b.* Adjust the AN/URM-25F TUNING control for a peak indication on the TS-585B/U. *Note.* If the TS-585B/U pointer goes off scale, adjust the receiver AF GAIN control to obtain a midscale indication. *c.* Adjust the receiver ANT TRIM control for a peak indication on the TS-585B/U meter. *d.* Adjust the receiver BFO PITCH control for a peak indication on the TS-585B/U. *e.* Adjust the AN/URM-25F MICROVOLTS control for an indication of 4 on the panel meter (3-10 MICROVOLTS scale). *f.* Adjust the receiver AF GAIN control for an indication of 10 milliwatts on the TS-585B/U. *g.* Set the receiver KILOCYCLES dial to 770 and note the indication on the TS-585B/U.	*a.* None. *b.* None. *c.* None. *d.* None. *e.* None. *f.* None. *g.* The TS-585B/U indicates not more than 1 milliwatt.
11	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: 1.5 MEGA-CYCLES. ATTENUATOR: 3. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-565B/U:* Same as step 1.	MEGACYCLES: 01. KILOCYCLES: 500. BAND WIDTH: 4 KC. BFO: ON. BFO PITCH: 0. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	*a.* Repeat test procedures in step 10*a* through *d*. *b.* Adjust the AN/URM-25F MICROVOLTS control for an indication of 3 on the panel meter (1-3 MICROVOLTS scale). *c.* Adjust the receiver AF GAIN control for an indication of 10 milliwatts on the TS-585B/U. *d.* Set the receiver KILOCYCLES dial to 520 and note the indication on the TS-585B/U.	*a.* None. *b.* None. *c.* None. *d.* The TS-585B/U indicates not more than 1 milliwatt.
12	*AN-URM-25F:* BAND SWITCH: 10-25. TUNING: 17 MEGA-CYCLES. ATTENUATOR: 3. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-585B/U:* Same as step 1.	MEGACYCLES: 17. KILOCYCLES: 000. BAND WIDTH: 4 KC. BFO: ON. BFO PITCH: 0. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	*a.* Repeat test procedures in step 10*a* through *d*. *b.* Adjust the AN/URM-25F MICROVOLTS control for an indication of 2 on the panel meter (1-3 MICROVOLTS scale). *c.* Adjust the receiver AF GAIN control for an indication of 10 milliwatts on the TS-585B/U. *d.* Set the receiver KILOCYCLES dial to 020 and note the indication on the TS-585B/U.	*a.* None. *b.* None. *c.* None. *d.* The TS-585B/U indicates not more than 1 milliwatt.
13	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: 1.5 MEGA-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *ME-30A/U:* Range selector switch: .1. *Note.* TS-585B/U not required for this step.	MEGACYCLES: 01. KILOCYCLES: 500. BAND WIDTH: 4 KC. BFO: OFF. AGC: ON. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: fully counterclockwise.	*a.* Connect ME-30A/U to the receiver as shown in figure 69. *b.* Adjust the AN/URM-25F SET RF OUTPUT control for a full-scale (10) indication on the MICROVOLTS scale of the panel meter. *c.* Adjust the AN/URM-25F TUNING control (in the vicinity of 1.5 mc) for a peak indication on the ME-30A/U. *d.* Adjust the receiver ANT TRIM control for a peak indication on the ME-30A/U and note this indication.	*a.* None. *b.* None. *c.* None. The ME-30A/U indicates not less than 24 millivolts (.24 on the 0-1.0 R.M.S. VOLTS scale).

Step No.	Test Equipment Required	Control Settings	Test Procedure	Performance Standard
1	AN/URM-32E. BAND SWITCH 350-500. TUNING 600 KILO-. CYCLES. ATTENUATOR 10. FUNCTION SWITCH CW. MICROVOLTS MAX. POWER ON. TS-35/U. Impedance coaxial 60X1/2 tube(s) Meter multiplier 1.	INAL LOCK fully counterclockwise. DATA ZERO fully counterclockwise. MODULATION on. RIGHT CYCLES 400. RANGE VOLTS 3-120. SIDE OFF. AUDIO OFF.	a. Make the following preliminary adjustments of the AN/URM-32E: (1) Adjust the SET RF CONTROL control for a full-scale (10) indication on the MICRO-VOLTS meter of the panel meter. (2) Set the FUNCTION SWITCH to MOD. (3) Adjust the % MOD AUDIO OUT LEVEL control for an indication of 30 on the panel meter (% MOD scale). b. Adjust the AN/URM-32E TUNING control for a peak indication on the TS-585B/U. c. Adjust the receiver AVC GAIN control for a peak indication on the TS-585B/U. d. Set the AN/URM-32E FUNCTION SWITCH to CW. e. Adjust the receiver AF GAIN control for an indication of 1 milliwatt on the TS-585B/U. f. Set the AN/URM-32E FUNCTION SWITCH to 400 and adjust the MOD CONTROL to obtain an indication of 10 milliwatts on the TS-585B/U. g. Decrease 6 through f above until an indication of 1 milliwatt on the TS-585B/U is obtained.	a. None. b. None. c. None. d. None. e. None. f. None. g. None.

95. Sensitivity Test
(fig. 89)

a. Test Equipment and Material.
RF Signal Generator AN/URM-32E.
Output Meter TS-585B/U.
Electronic Voltmeter ME-30(*)/U.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical Special Purpose Power Cable Assembly CX-1537/U or equivalent.
Test leads, 2 each.
Alligator clips, 2 each.

b. Test Connections and Conditions. Except for Electronic Voltmeter ME-30A/U, connect the equipment as shown in figure 89. Do not connect Electronic Voltmeter ME-30A/U until instructed to do so in the test procedures of step No. 15.

c. Procedure.

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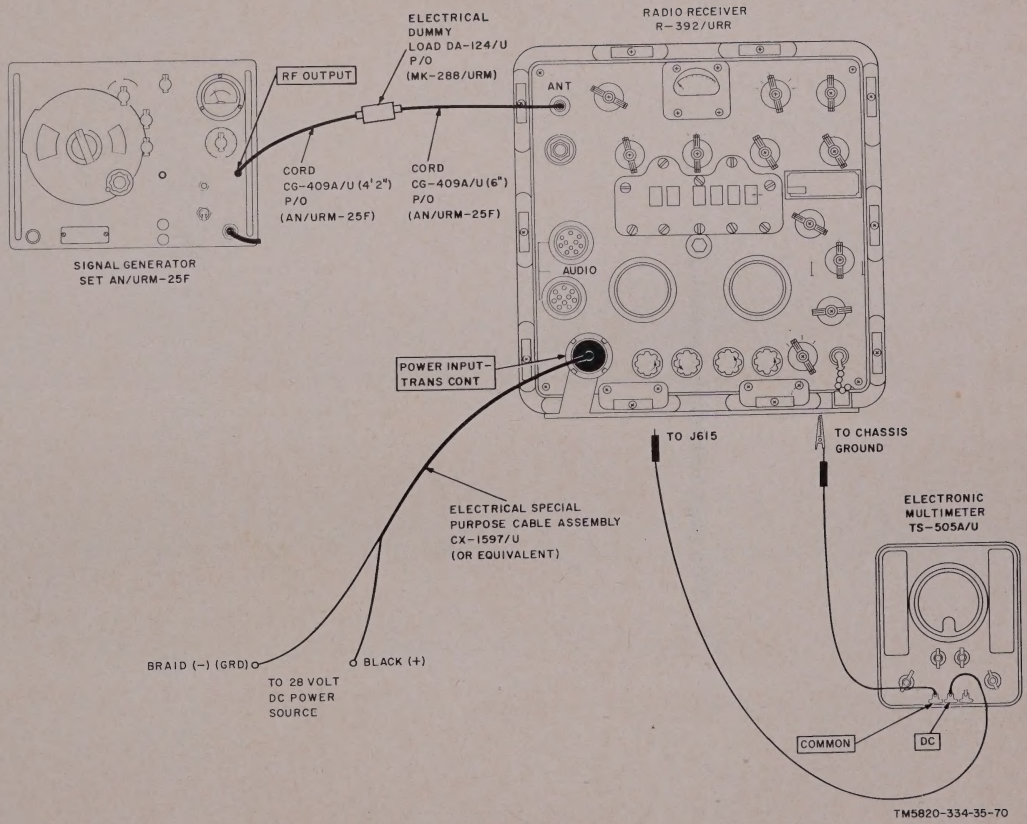

Figure 70. Selectivity test.

97. Selectivity Test

(fig. 70)

a. Test Equipment and Materials.

RF Signal Generator AN/URM-25F.
Electronic Multimeter TS-505A/U.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.

b. Test Connections and Conditions. Connect the equipment as shown in figure 70.

c. Procedure.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedures	Performance standard
1	*AN/URM-25F:* BAND SWITCH: 3.8-10	DIAL LOCK: fully counterclockwise. DIAL ZERO: fully counterclockwise	*a.* Zero the TS-505A/U as follows: (1) Remove the D.C. probe from jack J615 on	*a.* None.
			dicates 7 volts. Note and record the KILOCYCLES dial reading.	
			d. Slowly turn the receiver KILOCYCLES control counterclockwise until the TS-505A/U meter again indicates 7 volts. Note and record the KILOCYCLE dial reading.	*d.* None.
			e. Compute the difference between the KILOCYCLE dial indications recorded in *c* and *d* above. This value is the bandwidth at 6 db down.	*e.* The difference between the two recorded KILOCYCLE dial indications is not more than 2.5 kc.
3	Same as step 1.	Same as step 1 except: BAND WIDTH 8 KC.	Repeat test procedures step 1*b* through *i*.	The difference between the two recorded KILOCYCLES dial indications is between 6.8 kc and 9.2 kc.
4	Same as step 1.		Repeat test procedures step 2*a* through *e*.	The difference between the two recorded KILOCYCLES dial indications is not more than 11.6 kc.

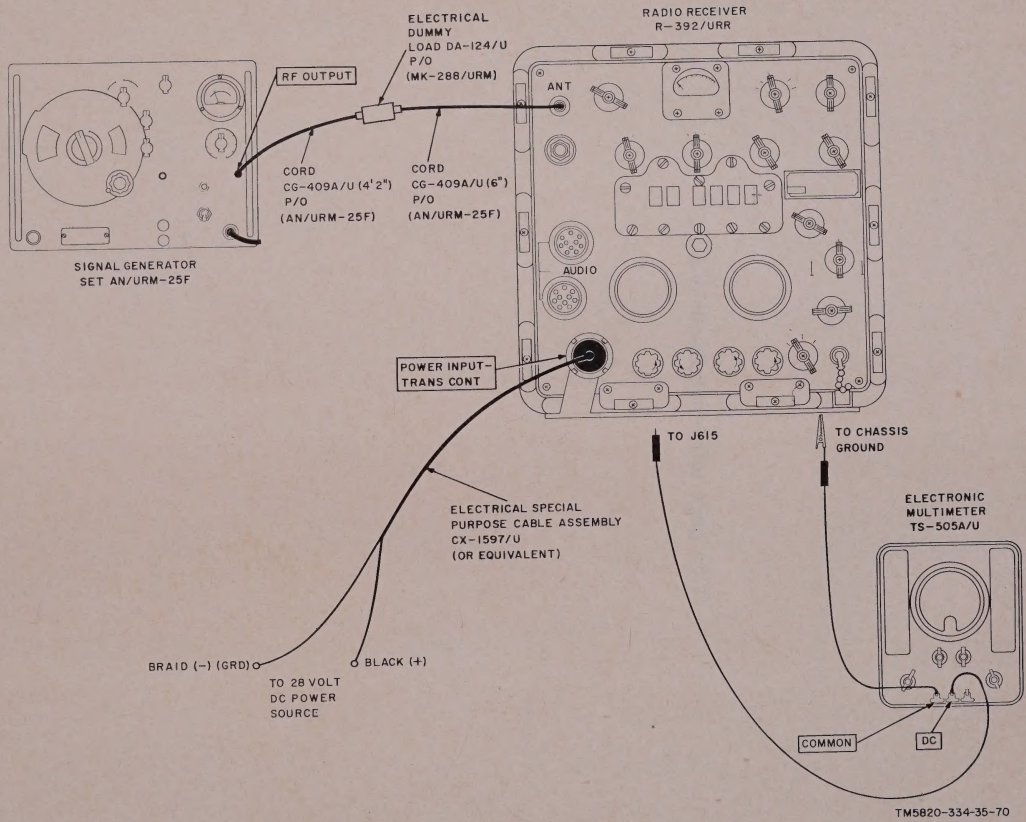

Figure 70. Selectivity test.

97. Selectivity Test
(fig. 70)

a. Test Equipment and Materials.

RF Signal Generator AN/URM-25F.
Electronic Multimeter TS-505A/U.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.

b. Test Connections and Conditions. Connect the equipment as shown in figure 70.

c. Procedure.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedures	Performance standard
1	*AN/URM-25F:* BAND SWITCH: 3.8-10. TUNING: 4.4 MEGACYCLES. ATTENUATOR: 30. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-505A/U:* FUNCTION: D.C. RANGE: 10V-RX100.	DIAL LOCK: fully counterclockwise. DIAL ZERO: fully counterclockwise. MEGACYCLES: 04. KILOCYCLES: 400. BAND WIDTH: 2 KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully counterclockwise. AF GAIN: fully counterclockwise.	*a.* Zero the TS-505A/U as follows: (1) Remove the D.C. probe from jack J615 on the receiver. (2) Set the RANGE switch to 2.5V-RX1 position. (3) Hold the D.C. and COMMON probe tips together and adjust the ZERO ADJ. control until the meter pointer indicates exactly 0 volts. (4) Set the RANGE switch to 5V-RX10 position.	*a.* None.
			b. Make the following preliminary adjustments of the AN/URM-25F controls: (1) Adjust the SET RF OUTPUT control for a full-scale (10) indication on the MIRCOVOLTS scale of the panel meter. (2) Adjust the MICROVOLTS control for an indication of 10 microvolts (1 on the 1-3 MICROVOLTS scale) on the panel meter.	*b.* None.
			c. Adjust the AN/URM-25F TUNING control (at approximately 4.4 mc) for a peak indication on the TS-505A/U.	*c.* None.
			d. Adjust the receiver ANT TRIM control for a peak indication on the TS-505A/U. *Note.* If the meter pointer goes off scale during the adjustments outlined in *c* and *d* above, reduce the receiver RF GAIN SQUELCH THRESH control setting.	*d.* None.
			e. Adjust the receiver RF GAIN SQUELCH THRESH control for an indication of 7 volts on the TS-505A/U.	*e.* None.
			f. Adjust the AN/URM-25F MICROVOLTS control for an indication of 14 microvolts on the panel meter (1.4 on the 1-3 MICROVOLTS scale).	*f.* None.
			g. Slowly turn the receiver KILOCYCLES control until the TS-505A/U meter again indicates 7 volts. Note and record the receiver KILOCYCLES dial indication.	*g.* None.
			h. Slowly turn the receiver KILOCYCLES control counterclockwise until the TS-505A/U meter again indicates 7 volts. Note and record the receiver KILOCYCLES dial indication.	*h.* None.
			i. Compute the difference between the KILOCYCLE dial indications recorded in *g* and *h* above. This value is the bandwidth at 3 db down.	*i.* The difference between the two recorded KILOCYCLE dial indications is not more than 2.0 kc.
2	Same as step 1.		*a.* Set the receiver KILOCYCLES dial to 400.	*a.* None.
			b. Adjust the AN/URM-25F MICROVOLTS control for an indication of 20 microvolts on the panel meter (2 on the 1-3 MICROVOLTS scale). *Note.* If the TS-505A/U meter pointer moves off scale, set the RANGE switch to the 20V-RX1000 position.	*b.* None.
			c. Slowly turn the receiver KILOCYCLES control clockwise until the TS-505A/U meter again indicates 7 volts. Note and record the KILOCYCLES dial reading.	*c.* None.
			d. Slowly turn the receiver KILOCYCLES control counterclockwise until the TS-505A/U meter again indicates 7 volts. Note and record the KILOCYCLE dial reading.	*d.* None.
			e. Compute the difference between the KILOCYCLE dial indications recorded in *c* and *d* above. This value is the bandwidth at 6 db down.	*e.* The difference between the two recorded KILOCYCLE dial indications is not more than 2.5 kc.
3	Same as step 1.	Same as step 1 except: BAND WIDTH 8 KC.	Repeat test procedures step 1*b* through *i*.	The difference between the two recorded KILOCYCLES dial indications is between 6.8 kc and 9.2 kc.
4	Same as step 1.		Repeat test procedures step 2*a* through *e*.	The difference between the two recorded KILOCYCLES dial indications is not more than 11.6 kc.

97. Selectivity Test
(fig. 70)

a. *Test Equipment and Materials.*

RF Signal Generator AN/URM-25F.
Electronic Multimeter TS-505A/U.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.

b. *Test Connections and Conditions.* Connect the equipment as shown in figure 70.

c. *Procedure.*

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedures	Performance standard
1	AN/URM-25F: BAND SWITCH: 3.8-10. TUNING: 4.4 MEGA-CYCLES. ATTENUATOR: 30. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. TS-505A/U: FUNCTION: D.C. RANGE: 10V-RX100.	DIAL LOCK: fully counterclockwise. DIAL ZERO: fully counterclockwise. MEGACYCLES: 64. KILOCYCLES: 400. BAND WIDTH: 2 KC. BFO: OFF. AGC: OFF. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully counterclockwise. AF GAIN: fully counterclockwise.	a. Zero the TS-505A/U as follows: (1) Remove the D.C. probe from jack J615 on the receiver. (2) Set the RANGE switch to 2.5V-RX1 position. (3) Hold the D.C. and COMMON probe tips together and adjust the ZERO ADJ. control until the meter pointer indicates exactly 0 volts. (4) Set the RANGE switch to 5V-RX10 position.	a. None.
			b. Make the following preliminary adjustments of the AN/URM-25F controls: (1) Adjust the SET RF OUTPUT control for a full-scale (10) indication on the MICROVOLTS scale of the panel meter. (2) Adjust the MICROVOLTS control for an indication of 10 microvolts (1 on the 1-3 MICROVOLTS scale) on the panel meter.	b. None.
			c. Adjust the AN/URM-25F TUNING control (at approximately 4.4 mc) for a peak indication on the TS-505A/U.	c. None.
			d. Adjust the receiver ANT TRIM control for a peak indication on the TS-505A/U.	d. None.

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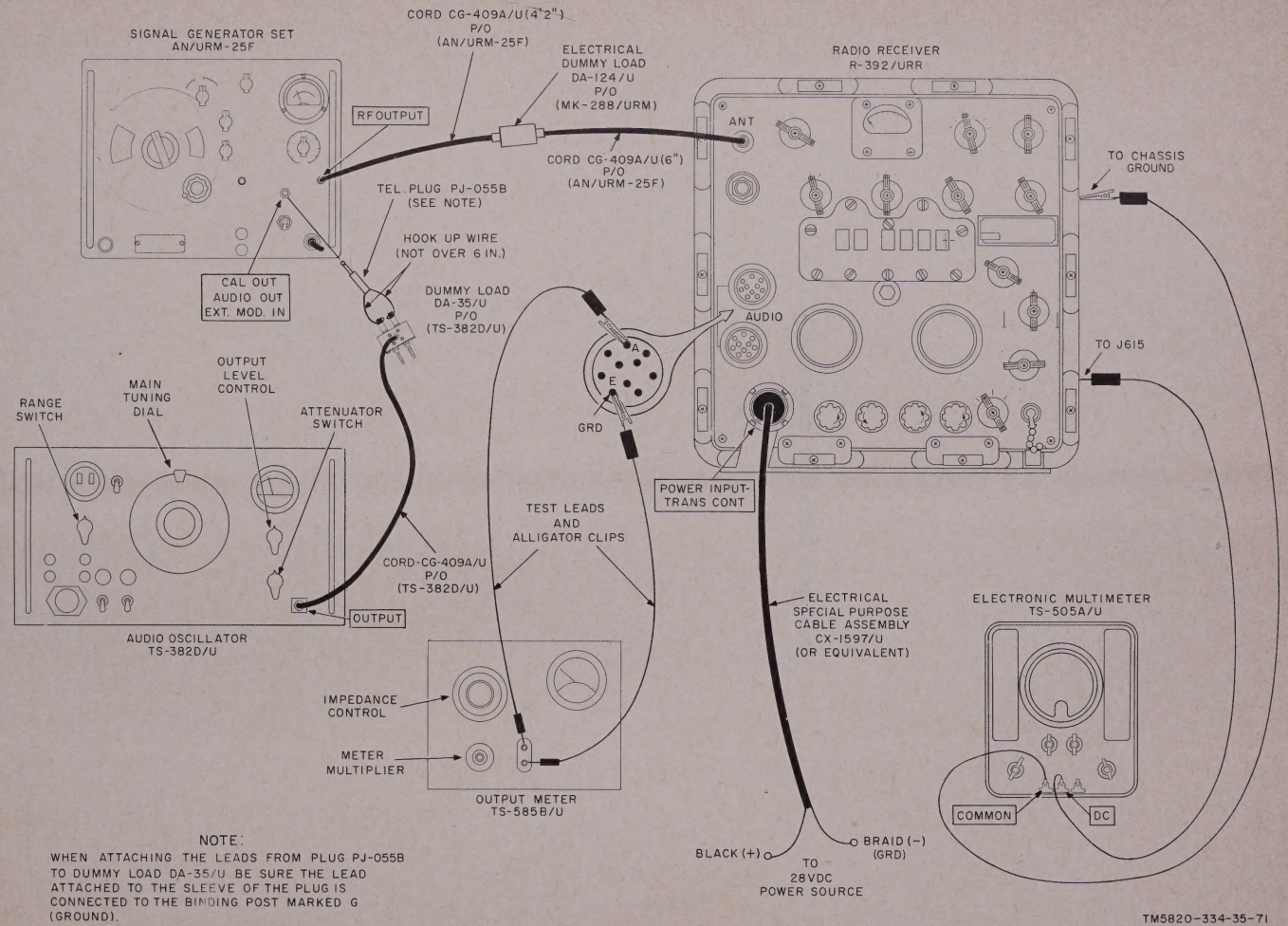

Figure 71. Overall audio response test.

98. Overall Audio Response Test

(fig. 71)

a. Test Equipment and Materials.

RF Signal Generator AN/URM-25F.
Audio Oscillator TS-382D/U.
Output Meter TS-585B/U.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.
Electronic Multimeter TS-505A/U.
Telephone Plug PJ-055B.
Test leads, 2 each.
Alligator clips, 2 each.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical wire (hookup wire 12").

b. Test Connections and Conditions. Connect the equipment as shown in figure 71.

c. Procedures.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedures	Performance standard
1	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: 1.5 MEGACYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW	MEGACYCLES: 01. KILOCYCLES: 500. BANDWIDTH: 8 KC. BFO: OFF. AGC: ON. Function switch: NORMAL	*a.* Adjust the output level control on the TS-382D/U for a full-scale indication on the panel meter. *b.* Make the following adjustments of the AN/URM-25F controls: (1) Adjust the SET RF OUTPUT control for a full-scale (1.0) indication on the panel	*a.* None. *b.* None.

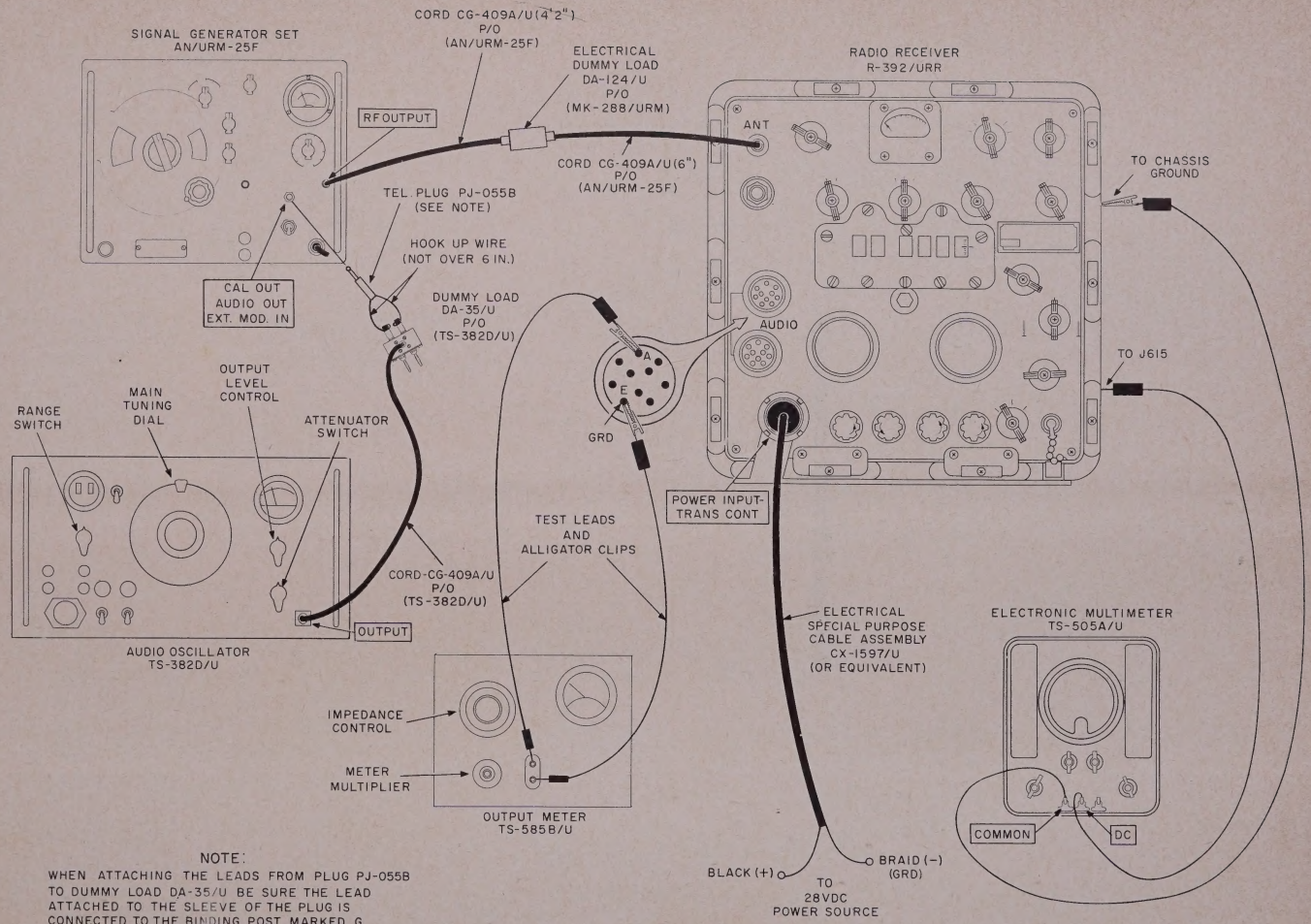

Figure 71. Overall audio response test.

98. Overall Audio Response Test
(fig. 71)

a. Test Equipment and Materials.
RF Signal Generator AN/URM-25F.
Audio Oscillator TS-382D/U.
Output Meter TS-585B/U.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.
Electronic Multimeter TS-505A/U.
Telephone Plug PJ-055B.
Test leads, 2 each.
Alligator clips, 2 each.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical wire (hookup wire 12").

b. Test Connections and Conditions. Connect the equipment as shown in figure 71.

c. Procedures.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedures	Performance standard
1	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: 1.5 MEGACYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-382D/U:* Main tuning dial: 40. Range switch: X10. Attenuator switch: X10. OSC power: ON. Impedance control: 60 (X10 bracket). Meter multiplier: 10. *TS-505A/U:* FUNCTION: -D.C. RANGE: 5V-RX10.	MEGACYCLES: 01. KILOCYCLES: 500. BANDWIDTH: 8 KC. BFO: OFF. AGC: ON. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: fully clockwise.	*a.* Adjust the output level control on the TS-382D/U for a full-scale indication on the panel meter. *b.* Make the following adjustments of the AN/URM-25F controls: (1) Adjust the SET RF OUTPUT control for a full-scale (10) indication on the panel meter. (2) Set the FUNCTION SWITCH to EXT. (3) Adjust the % MOD AUDIO OUT LEVEL control for an indication of 30 on the panel meter (% MOD scale). *c.* Adjust the AN/URM-25F TUNING control for a peak indication on the TS-505A/U. *d.* Adjust the receiver ANT TRIM control for a peak indication on the TS-505A/U. Note the TS-585B/U indication.	*a.* None. *b.* None. *c.* None. *d.* The TS-585B/U indicates not less than 200 milliwatts.
2	*AN/URM-25F:* FUNCTION SWITCH: CW. ATTENUATOR: 1K. *TS-585B/U:* Meter multiplier: 1. *TS-382D/U:* Main tuning dial: 100.	AF GAIN: fully counterclockwise.	*a.* Repeat test procedure step 1*b*. *b.* Adjust the receiver AF GAIN control for an indication of 10 milliwatts on the TS-585B/U. *c.* Set the TS-382D/U main tuning dial to 30 and note the indication on the TS-585B/U. *d.* Set the TS-382D/U main tuning dial to 160 and note the indication on the TS-585B/U.	*a.* None. *b.* None. *c.* The TS-585B/U indicates between 5 and 13 on the MILLIWATTS scale. *d.* Same as c above.
3	*TS-382D/U:* Main tuning dial: 25. Range switch: X100. Attenuator switch: X10. OSC power: ON.		*a.* Adjust the AN/URM-25F % MOD AUDIO OUT LEVEL control for an indication of 30 on the panel meter (% MOD scale). *b.* Note the indication on the TS-585B/U. *c.* Set the TS-382D/U main tuning dial to 35 and note the indication on the TS-585B/U. *d.* Set the TS-382D/U main tuning dial to 50 and note the indication on the TS-585B/U.	*a.* None. *b.* The TS-585B/U indicates between 5 and 13 on the milliwatts scale. *c.* The TS-585B/U indicates not more than 1 on the milliwatts scale. *d.* The TS-585B/U indicates not more than 1 on the MILLIWATTS scale.

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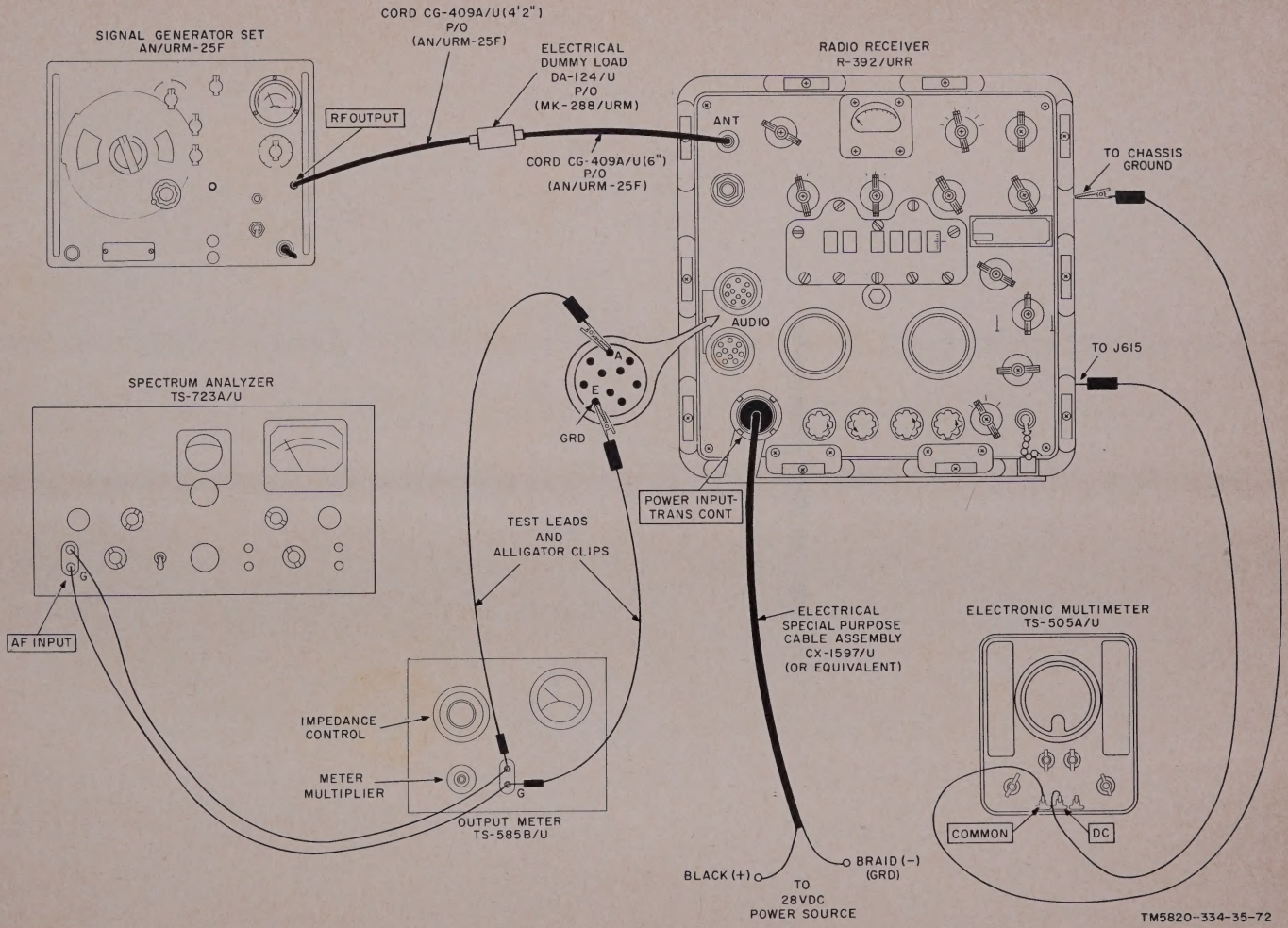

Figure 72. Distortion test.

99. Distortion Test
(fig. 72)

a. Test Equipment and Materials.
RF Signal Generator AN/URM-25F.
Spectrum Analyzer TS-723(A)/U.
Output Meter TS-585B/U.
Electronic Multimeter TS-505A/U.
Test leads, 4 each.
Alligator clips, 2 each.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.
Telephone Plug PJ-055B.
Electrical wire (hookup wire, 12").

b. Test Connections and Conditions. Connect the equipment as shown in figure 72.

c. Procedure.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedure	Performance standard
1	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: 1.5 MEGA-	MEGACYCLES: 01. KILOCYCLES: 500. BAND WIDTH: 8 KC.	*a.* Make the following preliminary adjustments of the AN/URM-25F controls: (1) Adjust the SET RF OUTPUT control for a	*a.* None.

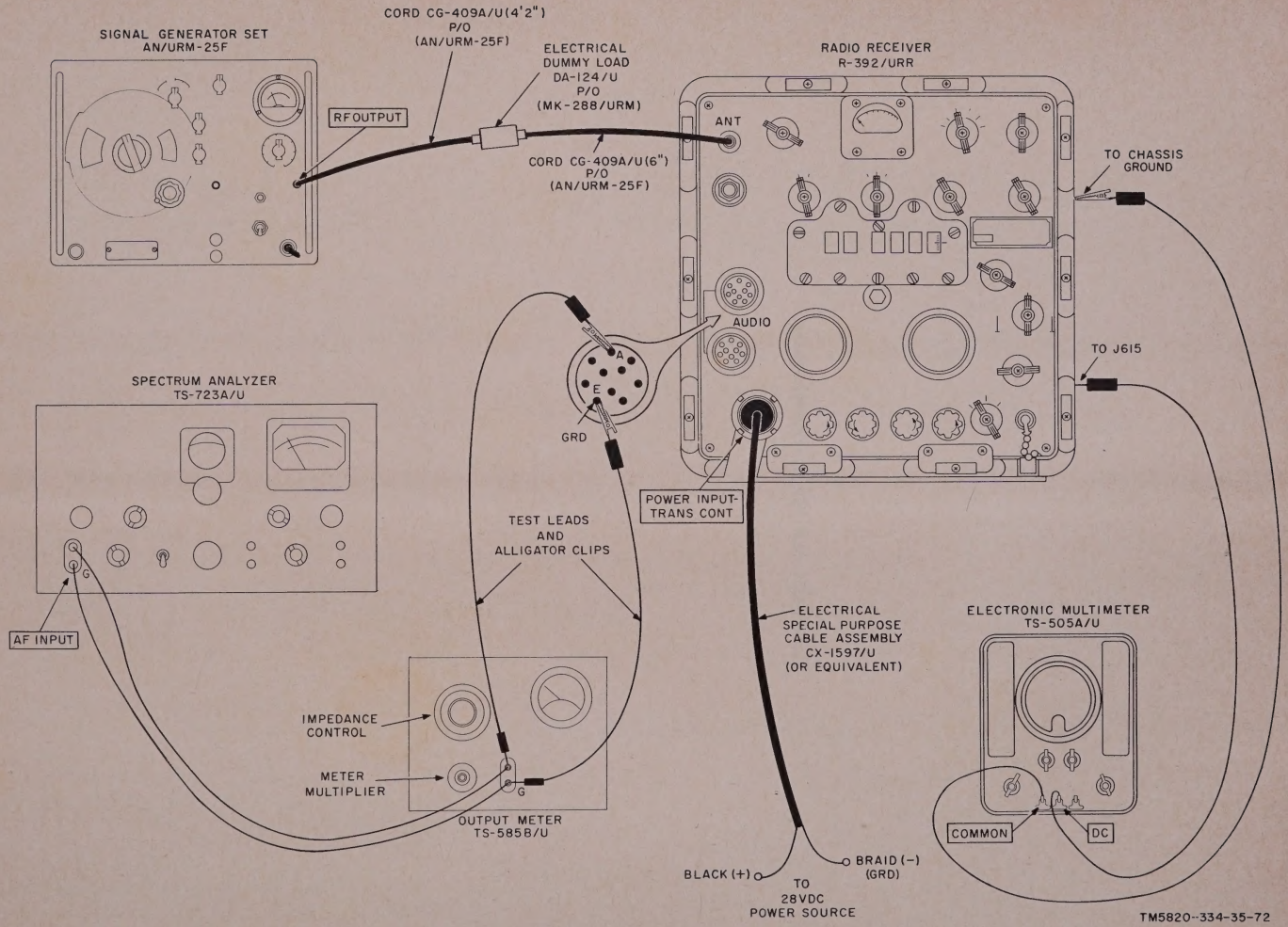

Figure 72. Distortion test.

99. Distortion Test
(fig. 72)

a. *Test Equipment and Materials.*
RF Signal Generator AN/URM-25F.
Spectrum Analyzer TS-723(A)/U.
Output Meter TS-585B/U.
Electronic Multimeter TS-505A/U.
Test leads, 4 each.
Alligator clips, 2 each.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.
Telephone Plug PJ-055B.
Electrical wire (hookup wire, 12").

b. *Test Connections and Conditions.* Connect the equipment as shown in figure 72.

c. *Procedure.*

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedure	Performance standard
1	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: 1.5 MEGACYCLES. ATTENUATOR: 1K. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-505A/U:* FUNCTION switch: -D.C. RANGE switch: 5V-RX10. *TS-585B/U:* Impedance control: 60 (X10) bracket. Meter multiplier: 10. *TS-723A/U:* INPUT: fully counterclockwise. RANGE: X10. AF-RF selector: AF. Function switch: SET LEVEL. Meter range switch: 100%. POWER: ON.	MEGACYCLES: 01. KILOCYCLES: 500. BAND WIDTH: 8 KC. BFO: OFF. AGC: ON. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise.	*a.* Make the following preliminary adjustments of the AN/URM-25F controls: (1) Adjust the SET RF OUTPUT control for a full-scale (10) indication on the panel meter. (2) Set the FUNCTION SWITCH to 400. (3) Adjust the % MOD AUDIO OUT LEVEL control for an indication of 30 on the panel meter (% MOD scale). *b.* Adjust the AN/URM-25F TUNING control for a peak indication on the TS-505A/U. *c.* Adjust the receiver ANT TRIM control for a peak indication on the TS-505A/U. *d.* Adjust the receiver AF GAIN control for an indication of 200 milliwatts on the TS-585B/U. *e.* Adjust the TS-723A/U AF INPUT control for a full-scale (1.0) indication on its panel meter. *f.* Set the TS-723A/U function switch to DISTORTION and adjust the FREQUENCY controls for a minimum indication on its panel meter. (This minimum indication should occur when the tuning dial is in the vicinity of 40). *g.* Adjust the TS-723A/U BALANCE control for a minimum indication on its panel meter; then note this indication.	*a.* None. *b.* None. *c.* None. *d.* None. *e.* None. *f.* None. *g.* The panel meter indicates not more than .1 on the 0-1.0 scale. (10% distortion).
2	Do not disturb control settings of test equipment.	Do not disturb control settings of the receiver.	Set the receiver function switch to LIMITER and note the indication on the TS-585B/U.	The TS-585B/U indicates not more than 150 milliwatts.

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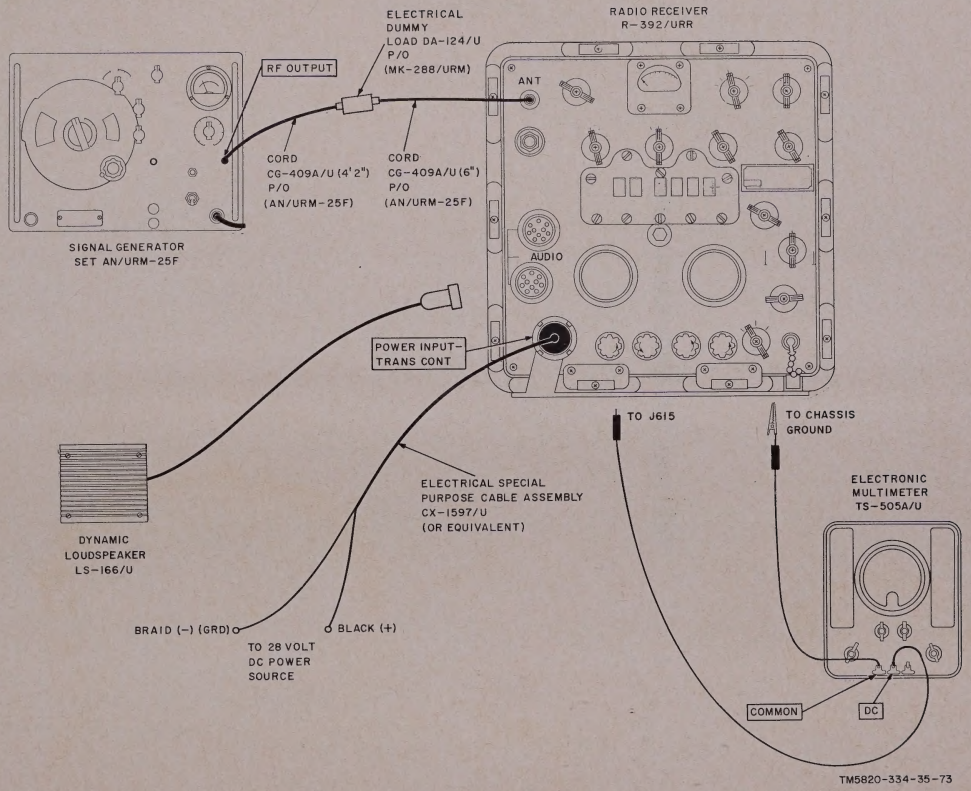


Figure 73. Squelch operation test.

100. Squelch Operation Test
(fig. 73)

a. Test Equipment and Materials.
RF Signal Generator AN/URM-25F.
Electronic Multimeter TS-505A/U.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical Special Purpose Cable Power Assembly CX-1597/U or equivalent.

b. Test Connections and Conditions. Connect the equipment as shown in figure 73.

c. Procedure.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedure	Performance standard
1	*AN/URM-25F:* BAND SWITCH: 0.6-1.5. TUNING: 1.5 MEGACYCLES. ATTENUATOR: 100. FUNCTION SWITCH: CW. MICROVOLTS: MAX. POWER: ON. *TS-505A/U:* FUNCTION switch: -D.C. RANGE switch: 5V-RX10.	MEGACYCLES: 01. KILOCYCLES: 500. BAND WIDTH: 2 KC. BFO: OFF. AGC: ON. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: Midposition.	*a.* Make the following preliminary adjustments of the AN/URM-25F controls: (1) Adjust the SET RF OUTPUT control for a full-scale (10) indication on the panel meter. (2) Adjust the MICROVOLTS control for an indication of 5 on the panel meter (3-10 MICROVOLTS scale). (3) Set the FUNCTION SWITCH to 400. (4) Adjust the % MOD AUDIO OUT LEVEL control for an indication of 30 on the panel meter (% MOD scale). *b.* Adjust the receiver KILOCYCLES control for a peak indication on the TS-505A/U. *c.* Adjust the receiver ANT TRIM control for a peak indication on the TS-505A/U. *d.* Turn the receiver RF GAIN SQUELCH THRESH control fully counterclockwise and set the function switch to the SQ position. *e.* Turn the receiver RF GAIN SQUELCH THRESH control slowly clockwise until sound is heard from the loudspeaker. Note the indication on the TS-505A/U. *f.* Turn the receiver RF GAIN control slowly counterclockwise until the sound coming from the loudspeaker suddenly stops. Note the indication on the TS-505A/U.	*a.* None. *b.* None. *c.* None. *d.* None. *e.* The TS-505A/U indicates not more than 2.8 volts. *f.* The TS-505A/U indicates not more than 0.8 volt.

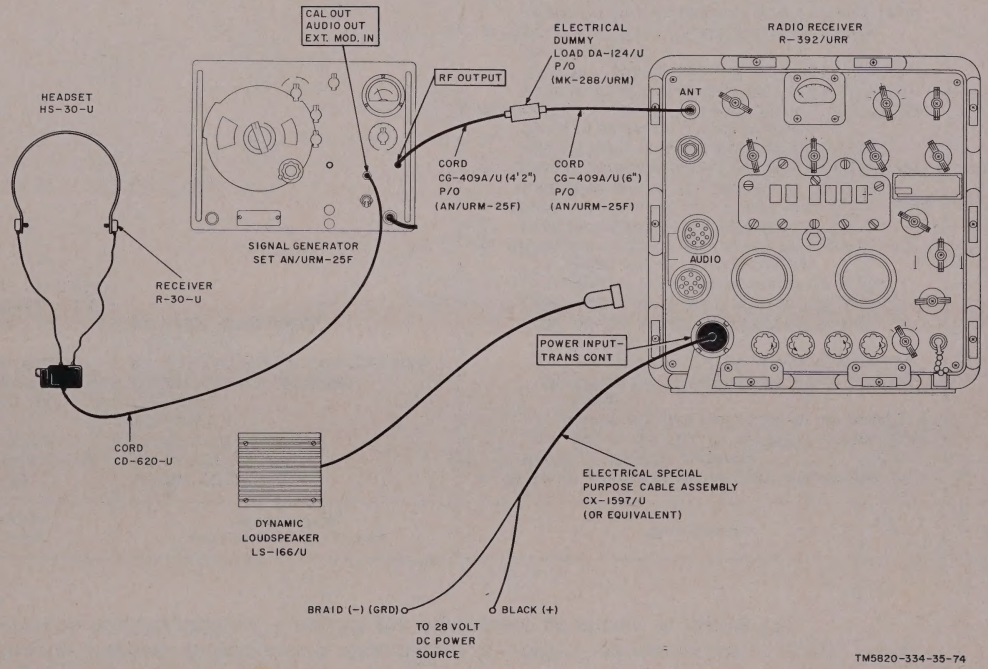


Figure 74. Calibration oscillator test.

101. Calibrating Oscillator Test
(fig. 74)

a. Test Equipment and Materials.
RF Signal Generator AN/URM-25F.
Dynamic Loudspeaker LS-166/U.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.
Headset HS-30.

b. Test Connections and/or Conditions. Connect the equipment as shown in figure 74.

c. Procedure.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedure	Performance standard
1	*AN/URM-25F:* BAND SWITCH: 3.8-10. TUNING: 5.0 MEGACYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CAL. MICROVOLTS: MAX. POWER: ON.	MEGACYCLES: 05. KILOCYCLES: 000. BAND WIDTH: 2 KC. BFO: OFF. AGC: ON. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	*a.* Calibrate the AN/URM-25 as follows: (1) Adjust the SET RF OUTPUT control for a full-scale (10) indication on the panel meter. (2) Adjust the TUNING control in the vicinity of the 5-megacycle dial mark for a zero-beat indication on the headset. (3) Set the FUNCTION SWITCH to CW. *b.* Adjust the receiver KILOCYCLES control for a peak indication on the CARRIER LEVEL meter.	*a.* None. *b.* None.

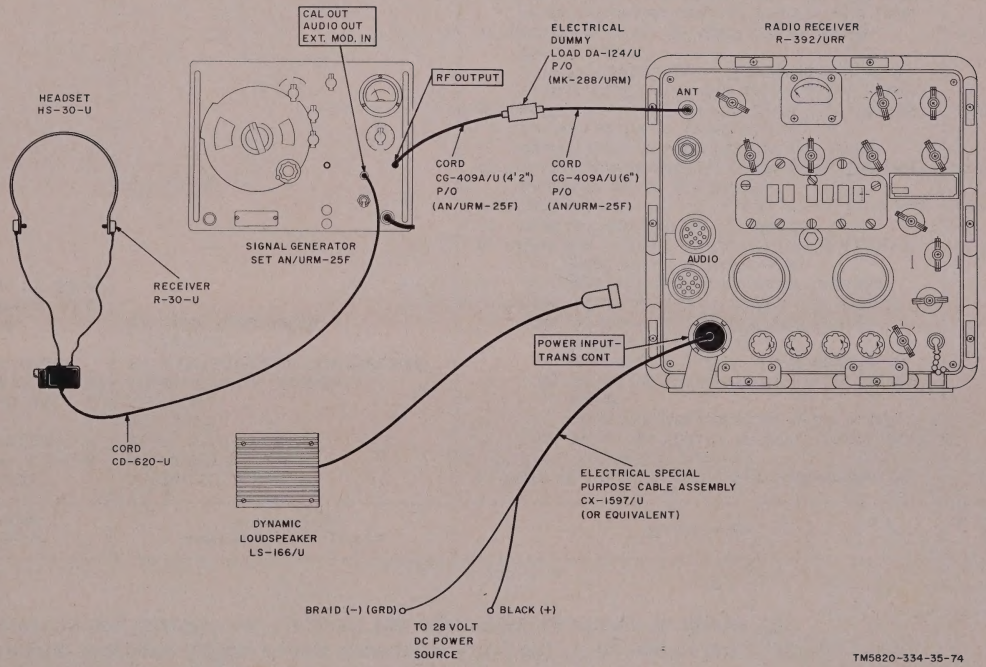


Figure 74. Calibration oscillator test.

101. Calibrating Oscillator Test
(fig. 74)

a. *Test Equipment and Materials.*
RF Signal Generator AN/URM-25F.
Dynamic Loudspeaker LS-166/U.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.
Headset HS-30.

b. *Test Connections and/or Conditions.* Connect the equipment as shown in figure 74.

c. *Procedure.*

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedure	Performance standard
1	*AN/URM-25F:* BAND SWITCH: 3.8-10. TUNING: 5.0 MEGACYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CAL. MICROVOLTS: MAX. POWER: ON.	MEGACYCLES: 05. KILOCYCLES: 000. BAND WIDTH: 2 KC. BFO: OFF. AGC: ON. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	*a.* Calibrate the AN/URM-25 as follows: (1) Adjust the SET RF OUTPUT control for a full-scale (10) indication on the panel meter. (2) Adjust the TUNING control in the vicinity of the 5-megacycle dial mark for a zero-beat indication on the headset. (3) Set the FUNCTION SWITCH to CW. *b.* Adjust the receiver KILOCYCLES control for a peak indication on the CARRIER LEVEL meter. *Note.* This adjustment is critical and must be made carefully. *c.* Adjust the receiver ANT TRIM control for a peak indication on the CARRIER LEVEL meter. *d.* Turn the receiver BFO switch knob to ON and adjust the BFO PITCH control for a zero-beat indication in the loudspeaker. *e.* Remove the AN/URM-25F cable from the receiver ANT receptacle and turn the receiver AGC control to CAL. Note the sound coming from the loudspeaker. *f.* Turn the receiver KILOCYCLES control clockwise while listening for a zero-beat indication from the loudspeaker.	*a.* None. *b.* None. *c.* None. *d.* The zero-beat indication is obtained with the BFO PITCH control within 1/2 division of 0. *e.* No beat note is heard from the loudspeaker. *f.* A zero-beat is indicated as the KILOCYCLES dial passes in the vicinity of the even hundred marks (100, 200, 300, etc).
2		MEGACYCLES: 27. KILOCYCLES: 000. BAND WIDTH: 2 KC. BFO: ON. AGC: CAL. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	Turn the receiver KILOCYCLES control clockwise while listening for zero-beat indication from the loudspeaker.	A zero-beat is indicated as KILOCYCLES dial passes in the vicinity of the even hundred marks (100, 200, 300, etc).

101. Calibrating Oscillator Test
(fig. 74)

a. Test Equipment and Materials.
RF Signal Generator AN/URM-25F.
Dynamic Loudspeaker 1.5-166/U.
Electronic Equipment Maintenance Kit MK-288/URM.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.
Headset HS-30.
b. Test Connections and/or Conditions. Connect the equipment as shown in figure 74.
c. Procedure.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedure	Performance standard
1	AN/URM-25F: BAND SWITCH: 3.9-10. TUNING: 5.0 MEGA-CYCLES. ATTENUATOR: 10. FUNCTION SWITCH: CAL. MODOVOLTS: MAX. POWER: ON.	MEGACYCLES: 05. KILOCYCLES: 000. BAND WIDTH: 2 KC. BFO: OFF. AGC: ON. Function switch: NORMAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	a. Calibrate the AN/URM-25 as follows: (1) Adjust the SET RF OUTPUT control for a full-scale (1.0) indication on the panel meter. (2) Adjust the TUNING control in the vicinity of the 5-megacycle dial mark for a zero-beat indication on the headset. (3) Set the FUNCTION SWITCH to CW. b. Adjust the receiver KILOCYCLES control for a peak indication on the CARRIER LEVEL meter. *Note. This adjustment is critical and must be made carefully*	a. None. b. None.
			c. Adjust the receiver ANT TRIM control for a peak indication on the CARRIER LEVEL meter. d. Turn the receiver BFO switch knob to ON and adjust the BFO PITCH control for a zero-beat indication in the loudspeaker.	c. None. d. The zero-beat indication is obtained with the BFO PITCH control within 1/2 division of 0.
			e. Remove the AN/URM-25F cable from the receiver ANT receptacle and turn the receiver AGC control to CAL. Note the sound coming from the loudspeaker. f. Turn the receiver KILOCYCLES control clockwise while listening for a zero-beat indication from the loudspeaker.	e. No beat note is heard from the loudspeaker. f. A zero-beat is indicated on the KILOCYCLES dial passes in the vicinity of the seven hundred marks (100, 200, 300, etc).
2		MEGACYCLES: 27. KILOCYCLES: 000.	Turn the receiver KILOCYCLES control clockwise while listening for zero-beat indication from the	A zero-beat is indicated as KILOCYCLES dial passes

102. Operational Tests
(fig. 75)

a. Test Equipment and Materials.

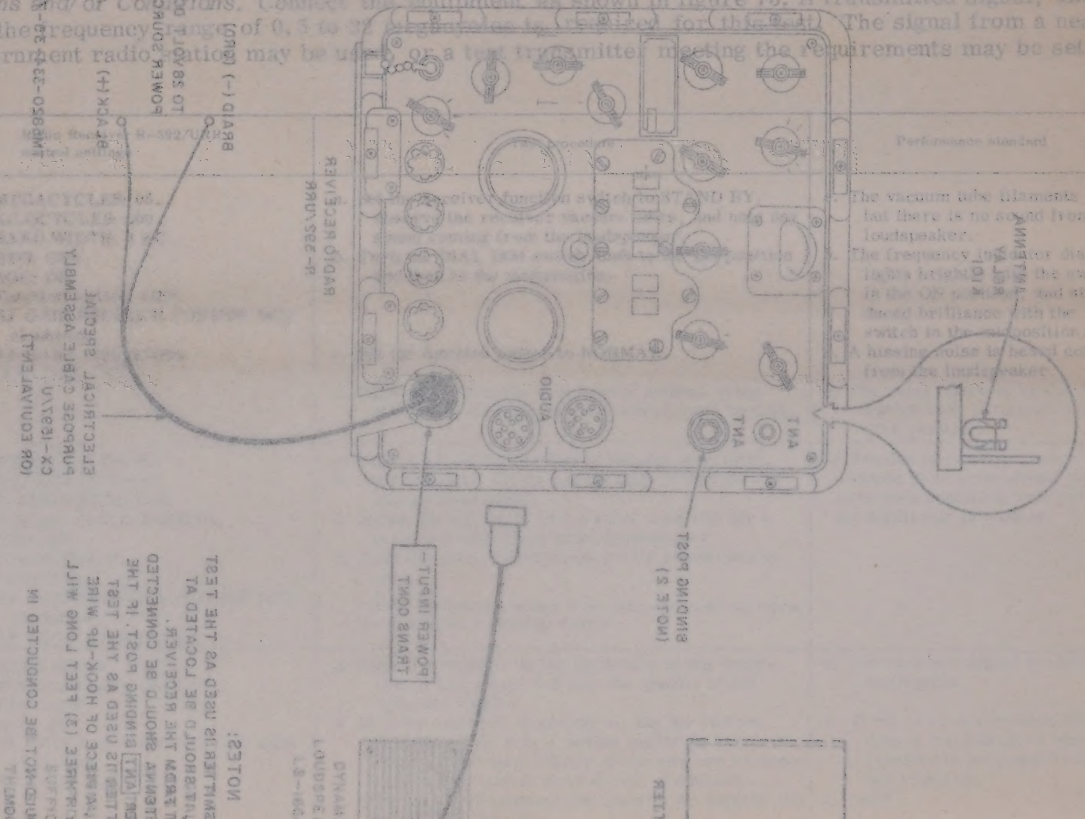
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.

Dynamic Loudspeaker LS-166/U.

Test transmitter (not required if a signal from a commercial or government radio station can be received).

b. Test Connections and/or Conditions. Connect the equipment as shown in figure 75. A transmitted signal, amplitude modulated, in the frequency range of 0.5 to 32 Mc/s (or the signal from a nearby commercial or government radio station may be used) or a test transmitter meeting the requirements may be set up.

c. Procedure.



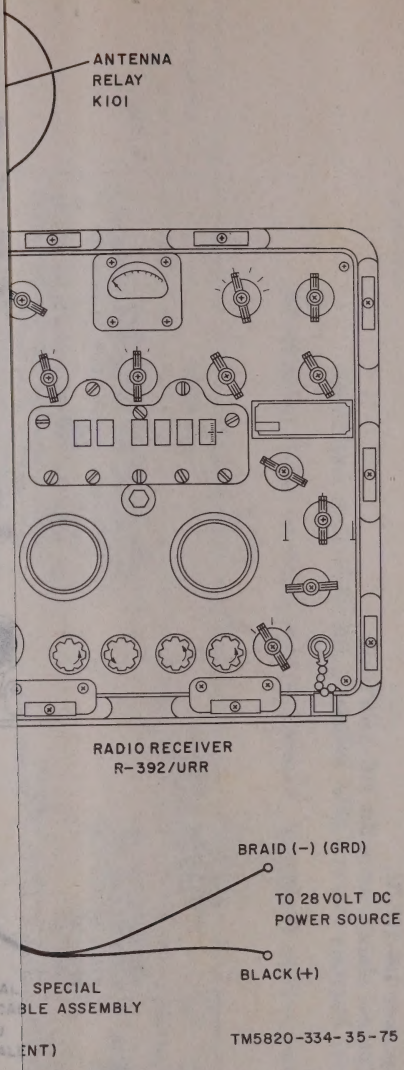


Figure 75. Operational test.

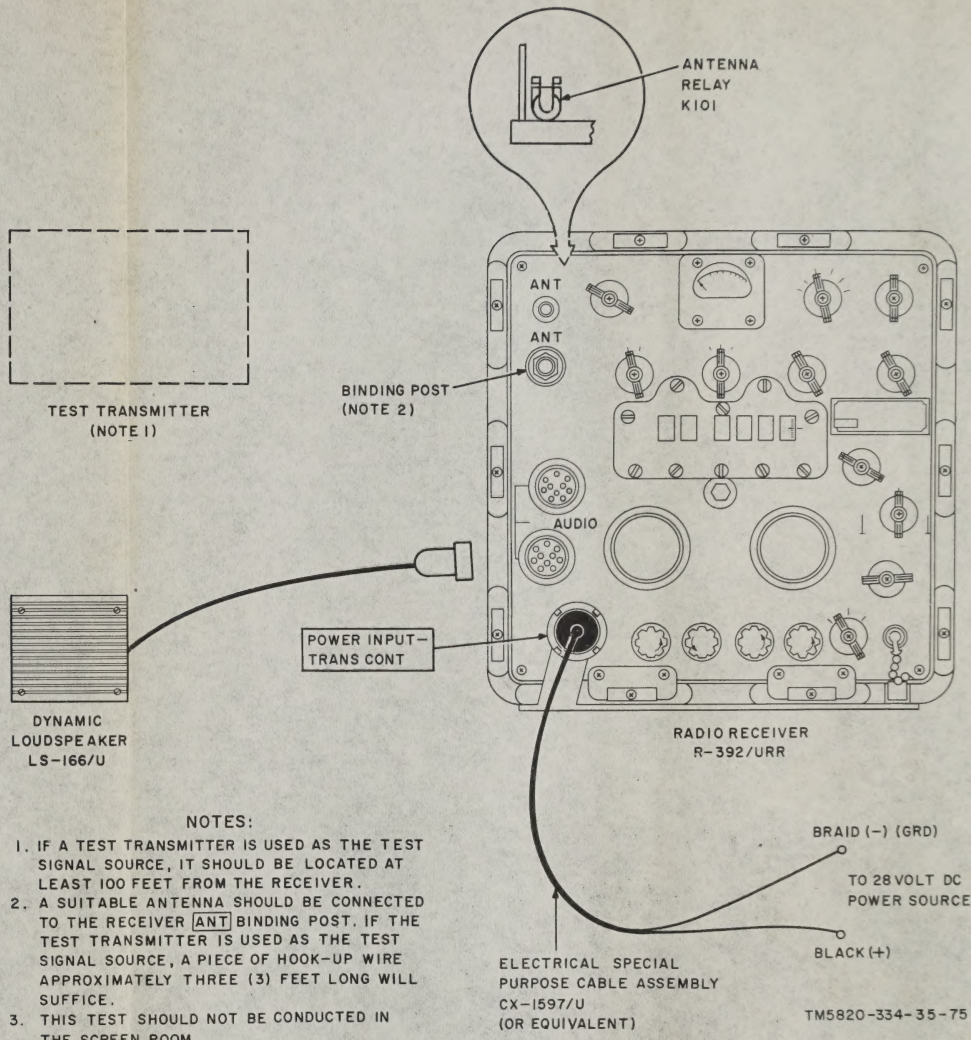
102. Operational Tests
(fig. 75)

a. Test Equipment and Materials.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.
Dynamic Loudspeaker LS-166/U.
Test transmitter (not required if a signal from a commercial or government radio station can be received).

b. Test Connections and/or Conditions. Connect the equipment as shown in figure 75. A transmitted signal, amplitude modulated, in the frequency range of 0.5 to 32 megacycles is required for this test. The signal from a nearby commercial or government radio station may be used, or a test transmitter meeting the requirements may be set up.

c. Procedure.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedure	Performance standard
1	None.	MEGACYCLES: 05. KILOCYCLES: 000. BAND WIDTH: 8 KC. BFO: OFF. AGC: ON. Function switch: OFF. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition. DIAL DIM: OFF.	*a.* Set the receiver function switch to STAND BY, observe the receiver vacuum tubes, and note any sound coming from the loudspeaker. *b.* Turn the DIAL DIM switch knob to the ON position and then to the midposition. *c.* Set the function switch to NORMAL. *d.* While observing the armature of antenna relay K101 (fig. 75), set the AGC switch knob to CAL.	*a.* The vacuum tube filaments light but there is no sound from the loudspeaker. *b.* The frequency indicator dial lights brightly with the switch in the ON position, and at reduced brilliance with the switch in the midposition. *c.* A hissing noise is heard coming from the loudspeaker. *d.* The relay operates as the AGC switch knob is turned to the CAL position.
2	None.	MEGACYCLES: 05. KILOCYCLES: 000. B AND WIDTH: 2 KC. Function switch: NORMAL. BFO: ON. BFO PITCH: 0. AGC: CAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	*a.* Set the KILOCYCLES dial at exactly zero (000). *b.* Turn the DIAL ZERO control fully clockwise and tighten fingertight. *c.* Adjust the KILOCYCLES control carefully for a zero-beat indication in the loudspeaker. *d.* Turn the DIAL ZERO control fully counterclockwise. *Note.* If there is a change in the zero-beat condition, repeat the procedures in *a* through *d* above.	Calibration is possible (zero dial indication (000) coincidental with zero-beat condition) with use of the applicable procedure.
3	None.	BAND WIDTH: 8 KC. Function switch: NORMAL. BFO: OFF. AGC: ON. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	*a.* Tune the receiver to the frequency of the transmitted test signal and note the quality of the received signal. *b.* With the receiver in operation, tap the various chassis gently with a padded mallet or similar object to simulate vibration and note any evidence of intermittents or microphonic conditions. *c.* Turn off and disconnect the equipment. Replace the receiver in its case.	*a.* The receiver signal is clear and intelligible. *b.* There is no intermittent operation or microphonics when the receiver is subjected to shock and vibration. *c.* None.



NOTES:

1. IF A TEST TRANSMITTER IS USED AS THE TEST SIGNAL SOURCE, IT SHOULD BE LOCATED AT LEAST 100 FEET FROM THE RECEIVER.
2. A SUITABLE ANTENNA SHOULD BE CONNECTED TO THE RECEIVER ANT BINDING POST. IF THE TEST TRANSMITTER IS USED AS THE TEST SIGNAL SOURCE, A PIECE OF HOOK-UP WIRE APPROXIMATELY THREE (3) FEET LONG WILL SUFFICE.
3. THIS TEST SHOULD NOT BE CONDUCTED IN THE SCREEN ROOM.

TM5820-334-35-75

Figure 76. Operational test.

102. Operational Tests
(fig. 75)

a. Test Equipment and Materials.
Electrical Special Purpose Power Cable Assembly CX-1597/U or equivalent.
Dynamic Loudspeaker LS-166/U.
Test transmitter (not required if a signal from a commercial or government radio station can be received).

b. Test Connections and/or Conditions. Connect the equipment as shown in figure 75. A transmitted signal, amplitude modulated, in the frequency range of 0.5 to 32 megacycles is required for this test. The signal from a nearby commercial or government radio station may be used, or a test transmitter meeting the requirements may be set up.

c. Procedure.

Step No.	Test equipment control settings	Radio Receiver R-392/URR control settings	Test procedure	Performance standard
1	None.	MEGACYCLES: 05. KILOCYCLES: 000. BAND WIDTH: 8 KC. BFO: OFF. AGC: ON. Function switch: OFF. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition. DIAL DIM: OFF.	*a.* Set the receiver function switch to STAND BY, observe the receiver vacuum tubes, and note any sound coming from the loudspeaker. *b.* Turn the DIAL DIM switch knob to the ON position and then to the midposition. *c.* Set the function switch to NORMAL. *d.* While observing the armature of antenna relay K101 (fig. 75), set the AGC switch knob to CAL.	*a.* The vacuum tube filaments light but there is no sound from the loudspeaker. *b.* The frequency indicator dial lights brightly with the switch in the ON position, and at reduced brilliance with the switch in the midposition. *c.* A hissing noise is heard coming from the loudspeaker. *d.* The relay operates as the AGC switch knob is turned to the CAL position.
2	None.	MEGACYCLES: 05. KILOCYCLES: 000. B AND WIDTH: 2 KC. Function switch: NORMAL. BFO: ON. BFO PITCH: 0. AGC: CAL. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	*a.* Set the KILOCYCLES dial at exactly zero (000). *b.* Turn the DIAL ZERO control fully clockwise and tighten fingertight. *c.* Adjust the KILOCYCLES control carefully for a zero-beat indication in the loudspeaker. *d.* Turn the DIAL ZERO control fully counterclockwise. *Note.* If there is a change in the zero-beat condition, repeat the procedures in *a* through *d* above.	Calibration is possible (zero dial indication (000) coincidental with zero-beat condition) with use of the applicable procedure.
3	None.	BAND WIDTH: 8 KC. Function switch: NORMAL. BFO: OFF. AGC: ON. RF GAIN SQUELCH THRESH: fully clockwise. AF GAIN: midposition.	*a.* Tune the receiver to the frequency of the transmitted test signal and note the quality of the received signal. *b.* With the receiver in operation, tap the various chassis gently with a padded mallet or similar object to simulate vibration and note any evidence of intermittents or microphonic conditions. *c.* Turn off and disconnect the equipment. Replace the receiver in its case.	*a.* The receiver signal is clear and intelligible. *b.* There is no intermittent operation or microphonics when the receiver is subjected to shock and vibration. *c.* None.

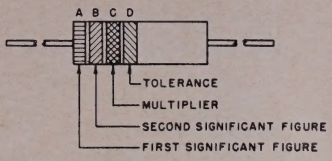
103. Summary of Performance Standards

Personnel may find it convenient to arrange data in a manner similar to that shown below.

	Performance Standard
1. AM SENSITIVITY	
a. 0.5-0.999 mc	9 uv or less
b. 1.0-1.999 mc	7 uv or less
c. 2.0-2.999 mc	10 uv or less
d. 3.0-4.999 mc	9 uv or less
e. 5.0-8.999 mc	6 uv or less
f. 9.0-32 mc	5 uv or less
2. CW SENSITIVITY	
a. 0.5-0.999 mc	4 uv or less
b. 1.0-2.0 mc	3 uv or less
c. 2.0-32.0 mc	2 uv or less
3. IF OUTPUT	24 millivolts minimum
4. SELECTIVITY	
a. BAND WIDTH switch in 8 KC position	
(1) 3 db down	6.8-9.2 kc
(2) 6 db down	11.6 kc or less
b. BAND WIDTH switch in 2 KC position	
(1) 3 db down	2.0 kc or less
(2) 6 db down	2.5 kc or less
5. AUDIO POWER OUTPUT 200 mw minimum (10 uv input modulated 30% at 400 cycles)	
6. OVERALL AUDIO RESPONSE	
a. 300-2,500 cycles	+1 db -3
b. 3,500 cycles	-5 db or more
c. 5,000 cycles	-10 db or more
7. DISTORTION (OVERALL) (1,000 uv input, modulated 30% at 400 cycles)	10% or less
8. SQUELCH THRESHOLD	
a. Squelch opens (diode load voltage)	2.8 volts or less
b. Squelch closes (diode load voltage)	0.8 volts or more

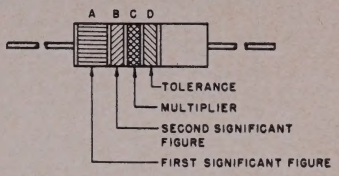
COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS

COMPOSITION-TYPE RESISTORS



BAND A— Equal Width Band Signifies Composition-Type

WIREWOUND-TYPE RESISTORS

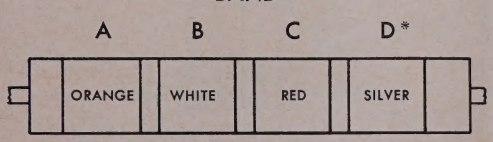


BAND A— Double Width Signifies Wire-wound Resistor

COLOR CODE TABLE

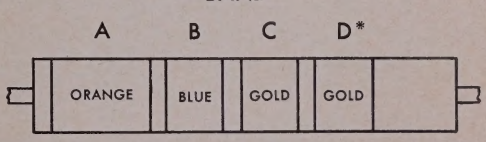
BAND A		BAND B		BAND C		BAND D*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1		
BROWN	1	BROWN	1	BROWN	10		
RED	2	RED	2	RED	100		
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	± 10
GREEN	5	GREEN	5	GREEN	100,000	GOLD	± 5
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	SILVER	0.01		
WHITE	9	WHITE	9	GOLD	0.1		

EXAMPLES OF COLOR CODING



NOMINAL RESISTANCE 3,900 Ohms

RESISTANCE TOLERANCE ± 10 percent



3.6 Ohms

± 5 percent

STD-R2

*If Band D is omitted, the resistor tolerance is ±20%, and the resistor is not Mil-Std.

Figure 76. MIL–STD resistor color code markings.

610-474 O - 62 - 9 (6132)

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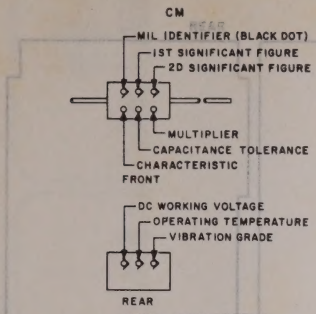
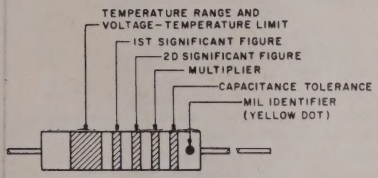
GROUP I Capacitors, Fixed, Various-



MICA-DIELECTRIC

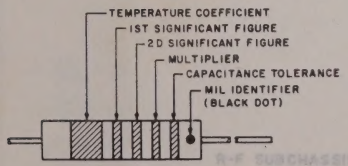
ORKING TAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
M	CM	CM
	−55° to +70°C	10–55 cps
	−55° to +85°C	
00		
	−55° to +125°C	10–2,000 cps
00		
	−55° to +150°C	

GROUP II Capacitors, Fixed Ceramic-



AXIAL LEAD

GROUP III Capacitors, Fixed, Cerami-



AXIAL LEAD

Temperature Compensating, Style CC

MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
	Capacitances over 10uuf	Capacitances 10uuf or less	
1		± 2.0uuf	CC
10	± 1%		
100	± 2%	± 0.25uuf	
1,000			
	± 5%	± 0.5uuf	
0.01			
0.1	± 10%		
		± 1.0uuf	

-C–10950 respectively.

STD-C2

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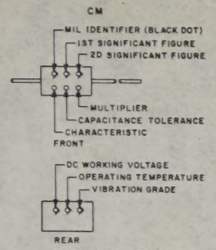
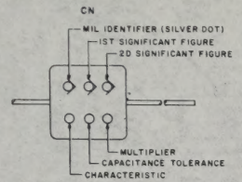
COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

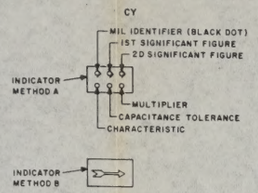
GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



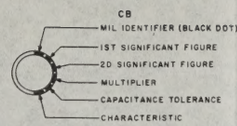
MICA-DIELECTRIC



PAPER-DIELECTRIC

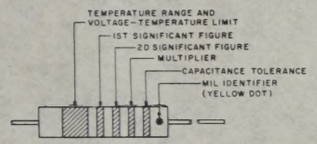


GLASS-DIELECTRIC, GLASS CASE

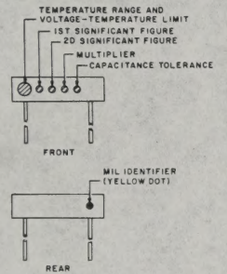


MICA, BUTTON TYPE

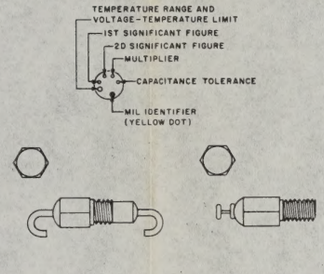
GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



AXIAL LEAD

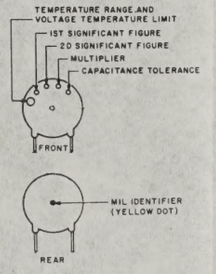


RADIAL LEAD



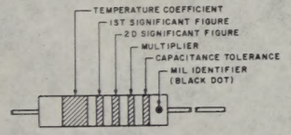
FEED-THROUGH

STAND-OFF

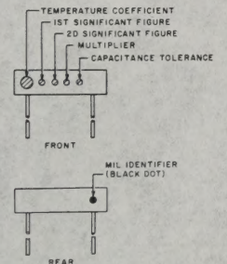


DISK-TYPE

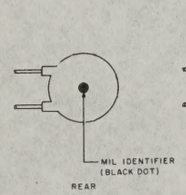
GROUP III Capacitors, Fixed, Ceramic-Dieletric (Temperature Compensating) Style CC

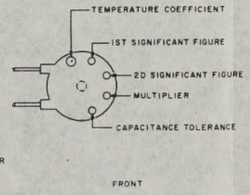


AXIAL LEAD



RADIAL LEAD





DISK-TYPE

Figure 77. MIL–STD capacitor color code markings.

COLOR CODE TABLES

TABLE I – For use with Group I, Styles CM, CN, CY and CB

COLOR	MIL ID	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE				CHARACTERISTIC[2]				DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CY	CB	CM	CM	CM
BLACK	CM, CY CB	0	0	1			± 20%	± 20%		A				−55° to +70°C	10–55 cps
BROWN		1	1	10					B	E		B			
RED		2	2	100	± 2%		± 2%	± 2%	C		C			−55° to +85°C	
ORANGE		3	3	1,000		± 30%			D			D	300		
YELLOW		4	4	10,000					E					−55° to +125°C	10–2,000 cps
GREEN		5	5		± 5%				F				500		
BLUE		6	6											−55° to +150°C	
PURPLE (VIOLET)		7	7												
GREY		8	8												
WHITE		9	9												
GOLD				0.1			± 5%	± 5%							
SILVER	CN				± 10%	± 10%	± 10%	± 10%							

TABLE II – For use with Group II, General Purpose, Style CK

COLOR	TEMP. RANGE AND VOLTAGE – TEMP. LIMITS[3]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE	MIL ID
BLACK		0	0	1	± 20%	
BROWN	AW	1	1	10	± 10%	
RED	AX	2	2	100		
ORANGE	BX	3	3	1,000		
YELLOW	AV	4	4	10,000		CK
GREEN	CZ	5	5			
BLUE	BV	6	6			
PURPLE (VIOLET)		7	7			
GREY		8	8			
WHITE		9	9			
GOLD						
SILVER						

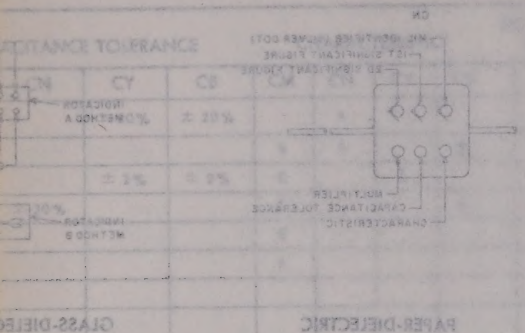
TABLE III – For use with Group III, Temperature Compensating, Style CC

COLOR	TEMPERATURE COEFFICIENT[4]	1st SIG FIG	2nd SIG FIG	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					Capacitances over 10uuf	Capacitances 10uuf or less	
BLACK	0	0	0	1		± 2.0uuf	CC
BROWN	−30	1	1	10	± 1%		
RED	−80	2	2	100	± 2%	± 0.25uuf	
ORANGE	−150	3	3	1,000			
YELLOW	−220	4	4				
GREEN	−330	5	5		± 5%	± 0.5uuf	
BLUE	−470	6	6				
PURPLE (VIOLET)	−750	7	7				
GREY		8	8	0.01			
WHITE		9	9	0.1	± 10%		
GOLD	+100					± 1.0uuf	
SILVER							

1. The multiplier is the number by which the two significant (SIG) figures are multiplied to obtain the capacitance in uuf.
2. Letters indicate the Characteristics designated in applicable specifications: MIL–C–5, MIL–C–91, MIL–C–11272, and MIL–C–10950 respectively.
3. Letters indicate the temperature range and voltage-temperature limits designated in MIL–C–11015.
4. Temperature coefficient in parts per million per degree centigrade.

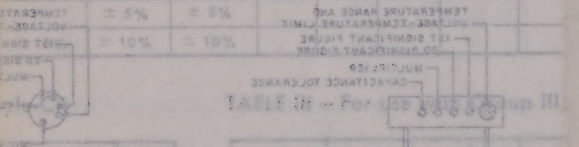
STD-C2

GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



MICA-DIELECTRIC

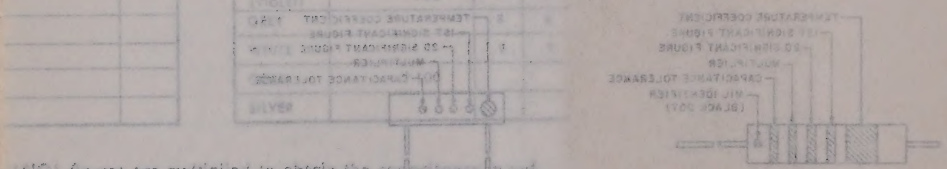
GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



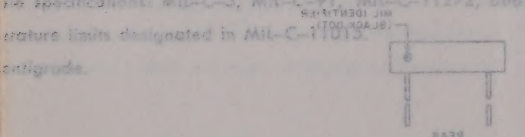
AXIAL LEAD

RADIAL LEAD

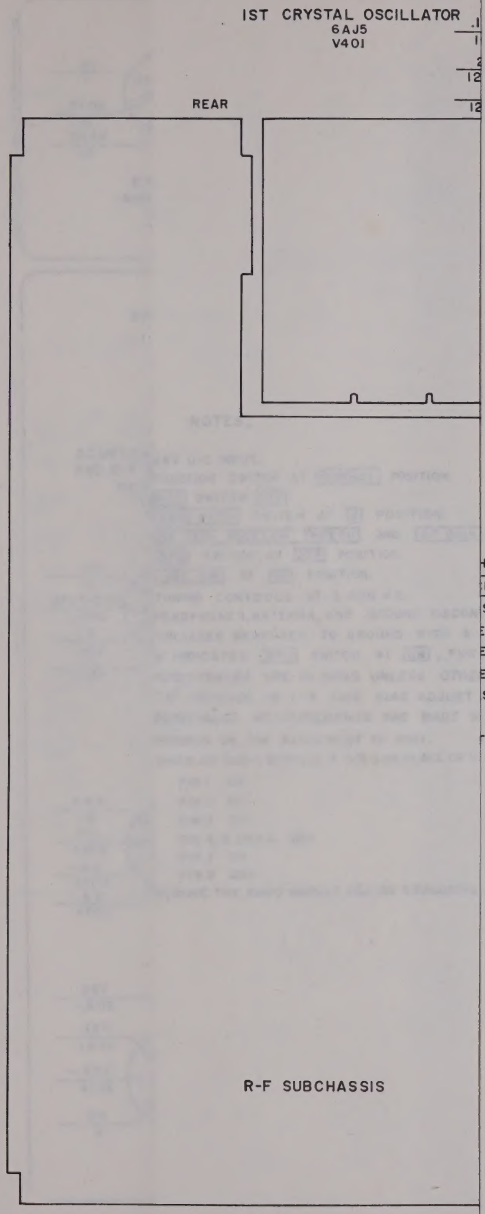
GROUP III Capacitors, Fixed, Ceramic-Dielectric (Temperature-Compensating) Style CC



AXIAL LEAD

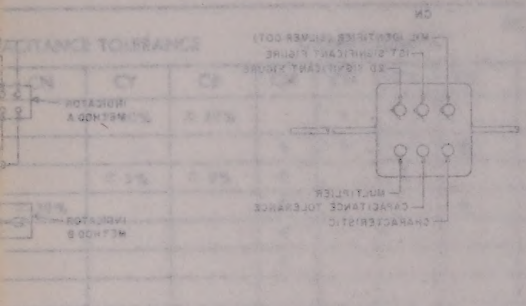


RADIAL LEAD



H AT [NORMAL] POSITION.
H THRESH AND [AF GAIN] AT MAX CW POSITION.
S AT 2.000 M.C.
ESISTANCES MEASURED TO GROUND WITH VTVM.
ENNA, AND GROUND DISCONNECTED.
E IN OHMS UNLESS OTHERWISE SHOWN.
SUREMENTS ARE MADE WITH ALL TUBES IN SOCKETS.
CONNECTION.
[OFF] POSITION.

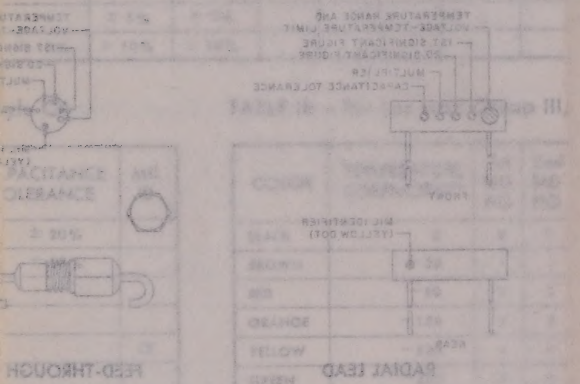
GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



MICA-DIELECTRIC

PAPER-DIELECTRIC

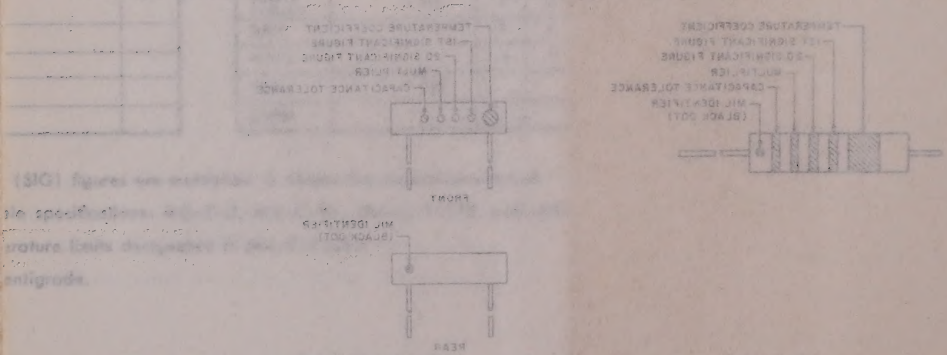
GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



AXIAL LEAD

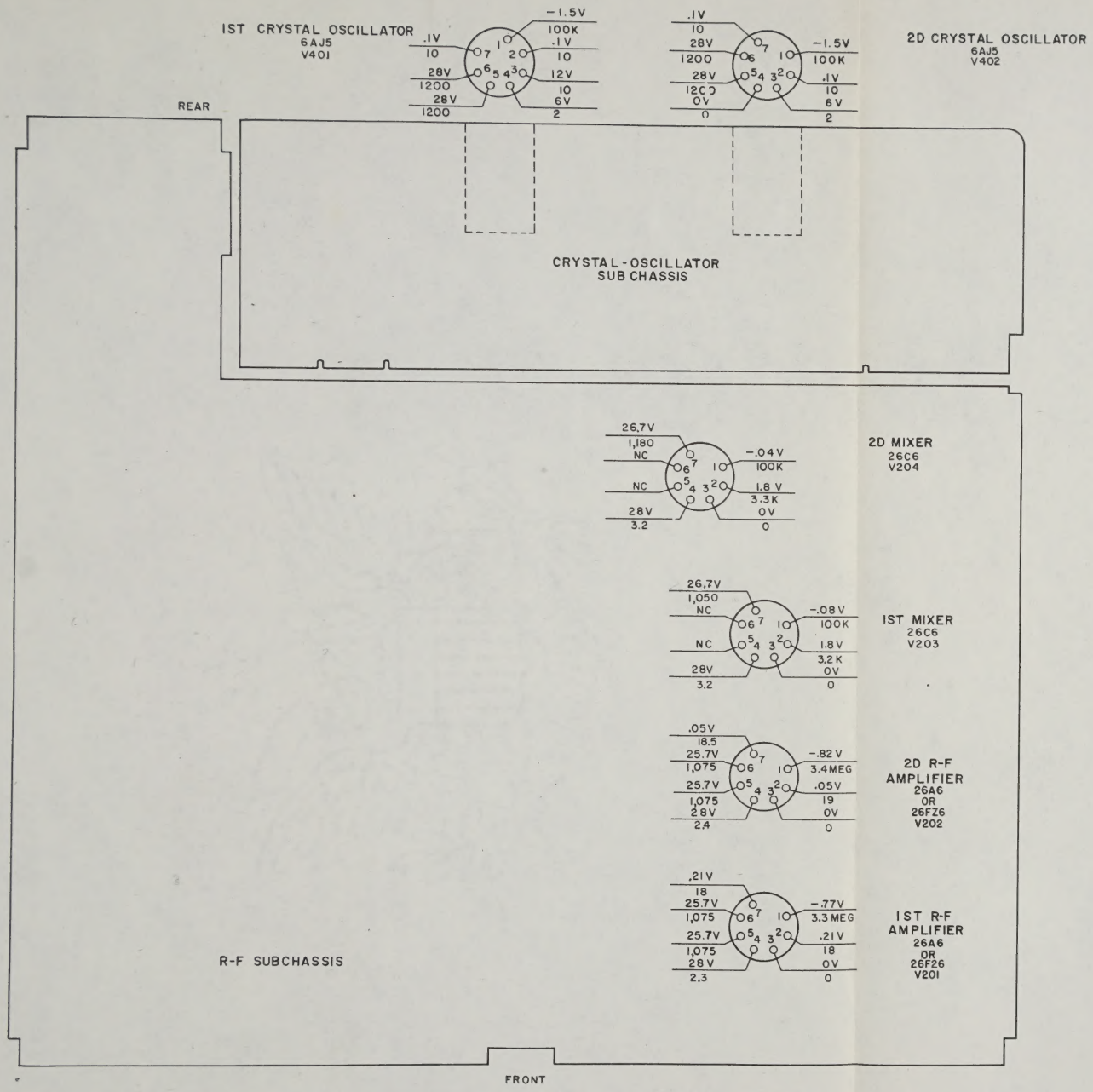
RADIAL LEAD

GROUP III Capacitors, Fixed, Ceramic-Dielectric (Temperature Compensating) Style CC



AXIAL LEAD

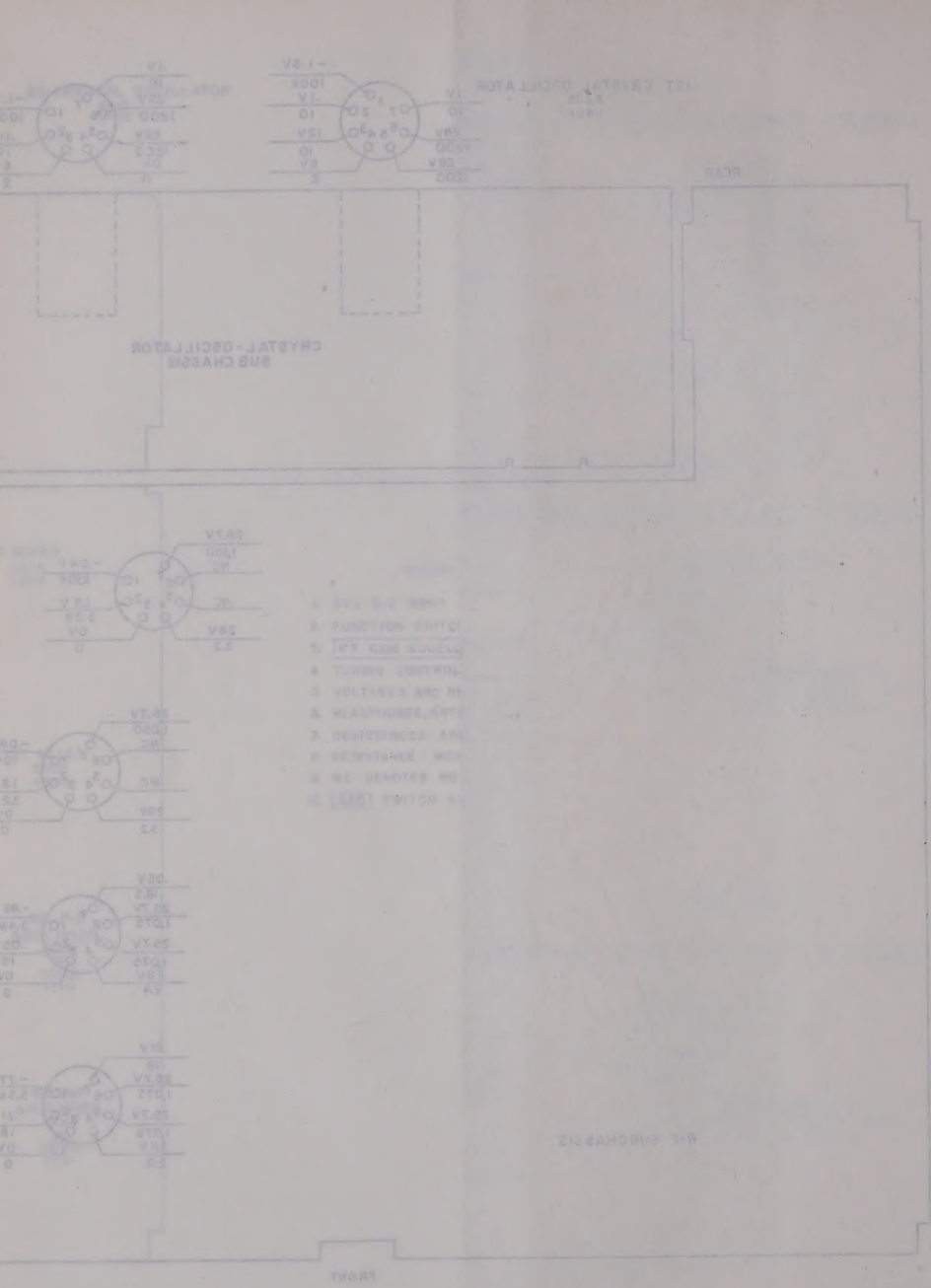
RADIAL LEAD

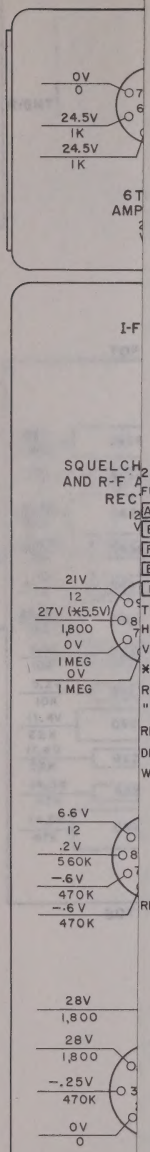


NOTES:

1. 28V D-C INPUT.
2. FUNCTION SWITCH AT NORMAL POSITION.
3. RF GAIN SQUELCH THRESH AND AF GAIN AT MAX CW POSITION.
4. TUNING CONTROLS AT 2.000 M.C.
5. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH VTVM.
6. HEADPHONES, ANTENNA, AND GROUND DISCONNECTED.
7. RESISTANCES ARE IN OHMS UNLESS OTHERWISE SHOWN.
8. RESISTANCE MEASUREMENTS ARE MADE WITH ALL TUBES IN SOCKETS.
9. NC DENOTES NO CONNECTION.
10. AGC SWITCH AT OFF POSITION.

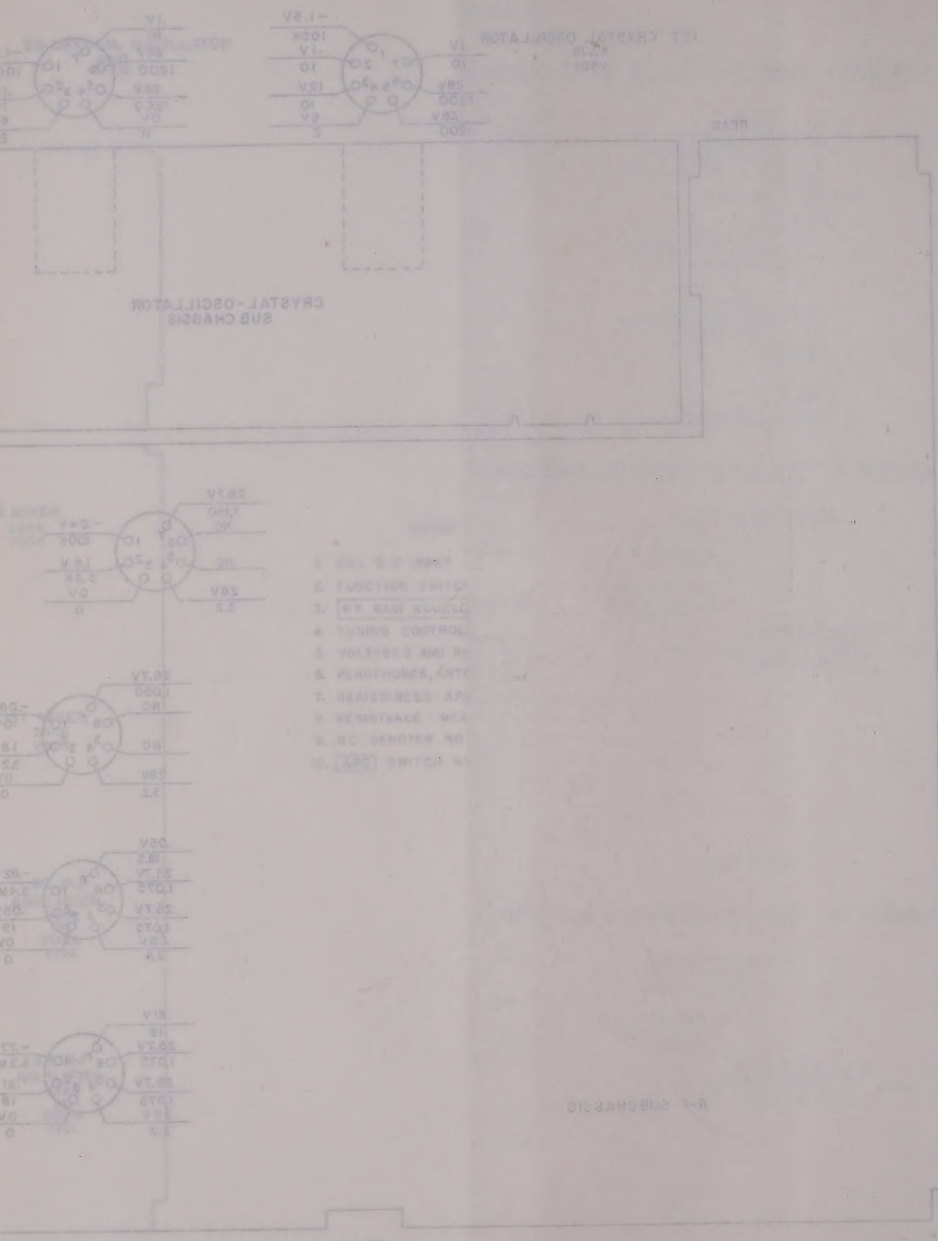
Figure 78. Upper deck, voltage and resistance diagram.

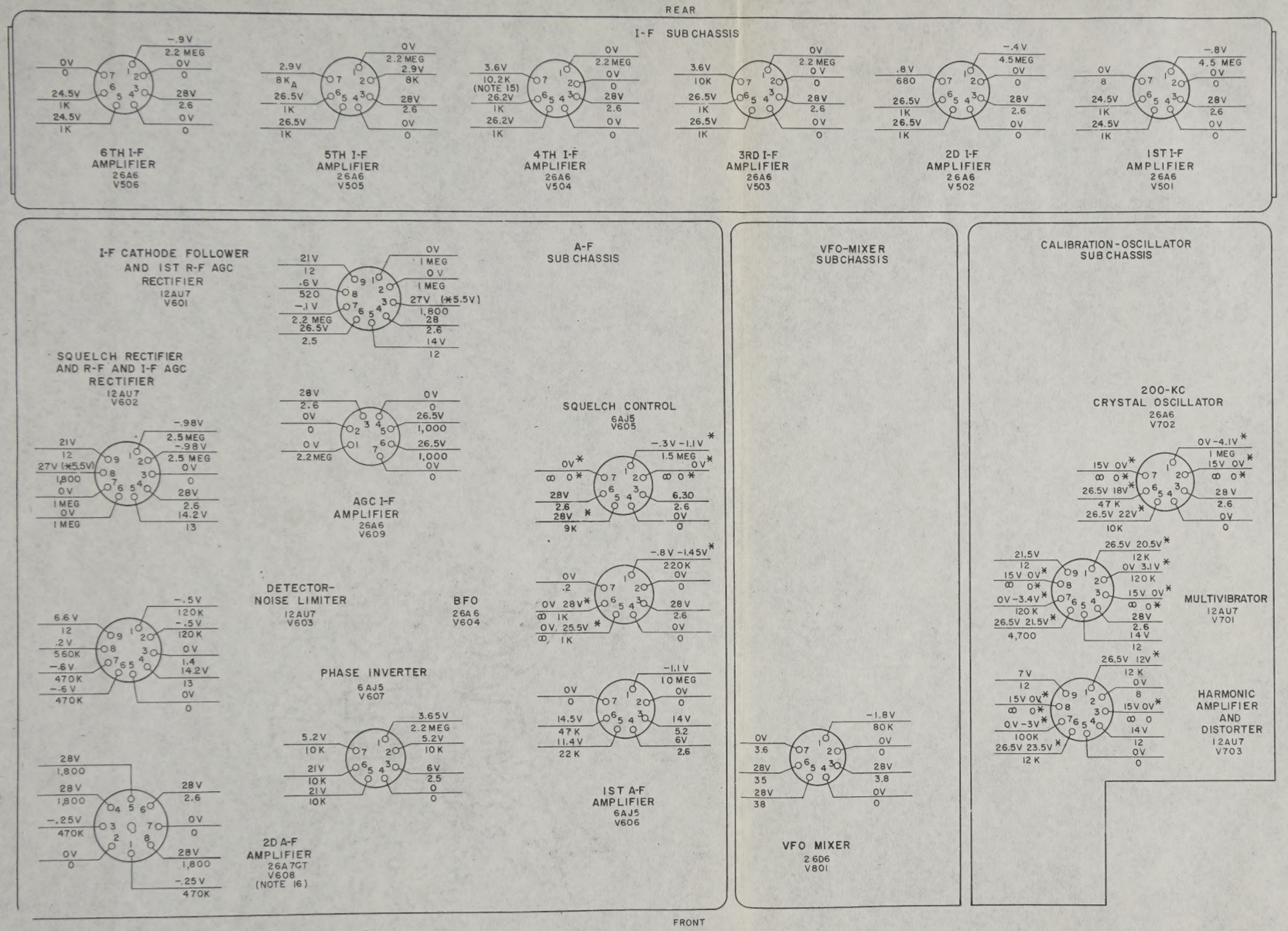




NOTES:

1. 28V D-C INPUT.
2. FUNCTION SWITCH AT NORMAL POSITION.
3. AGC SWITCH OFF
4. BAND WIDTH SWITCH AT 2 POSITION.
5. RF GAIN SQUELCH THRESH AND AF GAIN AT MAX CW POSITION.
6. BFO SWITCH AT OFF POSITION.
7. DIAL DIM AT ON POSITION.
8. TUNING CONTROLS AT 2.000 MC.
9. HEADPHONES, ANTENNA, AND GROUND DISCONNECTED.
10. VOLTAGES MEASURED TO GROUND WITH A VTVM.
11. * INDICATES BFO SWITCH AT ON, FUNCTION SWITCH AT SQ, AND AGC SWITCH AT CAL.
12. RESISTANCES ARE IN OHMS UNLESS OTHERWISE SHOWN.
13. "A" DEPENDS ON I-F GAIN BIAS ADJUST SETTING.
14. RESISTANCE MEASUREMENTS ARE MADE WITH ALL TUBES IN SOCKETS.
15. DEPENDS ON THE ADJUSTMENT OF R521.
16. WHEN AN AUDIO MODULE IS USED IN PLACE OF V608, THE VOLTAGES ARE AS FOLLOWS:
    - PIN 1 0V
    - PIN 2 0V
    - PIN 3 2V
    - PIN 4,5 AND 6 28V
    - PIN 7 0V
    - PIN 8 28V
17. REMOVE THE AUDIO MODULE BEFORE MEASURING RESISTANCES.


CRYSTAL-OSCILLATOR
SUB CHASSIS


REAR
I-F SUB CHASSIS
6TH I-F AMPLIFIER 26A6 V506
5TH I-F AMPLIFIER 26A6 V505
4TH I-F AMPLIFIER 26A6 V504
3RD I-F AMPLIFIER 26A6 V503
2D I-F AMPLIFIER 26A6 V502
1ST I-F AMPLIFIER 26A6 V501
I-F CATHODE FOLLOWER AND 1ST R-F AGC RECTIFIER 12AU7 V601
SQUELCH RECTIFIER AND R-F AND I-F AGC RECTIFIER 12AU7 V602
A-F SUB CHASSIS
AGC I-F AMPLIFIER 26A6 V609
SQUELCH CONTROL 6AJ5 V605
DETECTOR-NOISE LIMITER 12AU7 V603
BFO 26A6 V604
PHASE INVERTER 6AJ5 V607
1ST A-F AMPLIFIER 6AJ5 V606
2D A-F AMPLIFIER 26A7GT V608 (NOTE 16)
VFO-MIXER SUBCHASSIS
VFO MIXER 2606 V801
CALIBRATION-OSCILLATOR SUBCHASSIS
200-KC CRYSTAL OSCILLATOR 6AB6 V702
MULTIVIBRATOR 12AU7 V701
HARMONIC AMPLIFIER AND DISTORTER 12AU7 V703
FRONT

NOTES:

1. 28V D-C INPUT.
2. FUNCTION SWITCH AT NORMAL POSITION.
3. AGC SWITCH OFF.
4. BAND WIDTH SWITCH AT 2 POSITION.
5. RF GAIN SQUELCH THRESH AND AF GAIN AT MAX CW POSITION.
6. BFO SWITCH AT OFF POSITION.
7. DIAL DIM AT ON POSITION.
8. TUNING CONTROLS AT 2.000 MC.
9. HEADPHONES, ANTENNA, AND GROUND DISCONNECTED.
10. VOLTAGES MEASURED TO GROUND WITH A VTVM.
11. * INDICATES BFO SWITCH AT ON, FUNCTION SWITCH AT SQ, AND AGC SWITCH AT CAL.
12. RESISTANCES ARE IN OHMS UNLESS OTHERWISE SHOWN.
13. "A" DEPENDS ON I-F GAIN BIAS ADJUST SETTING.
14. RESISTANCE MEASUREMENTS ARE MADE WITH ALL TUBES IN SOCKETS.
15. DEPENDS ON THE ADJUSTMENT OF R521.
16. WHEN AN AUDIO MODULE IS USED IN PLACE OF V608, THE VOLTAGES ARE AS FOLLOWS:
    PIN 1 0V
    PIN 2 0V
    PIN 3 2V
    PIN 4,5 AND 6 28V
    PIN 7 0V
    PIN 8 28V
    REMOVE THE AUDIO MODULE BEFORE MEASURING RESISTANCES.

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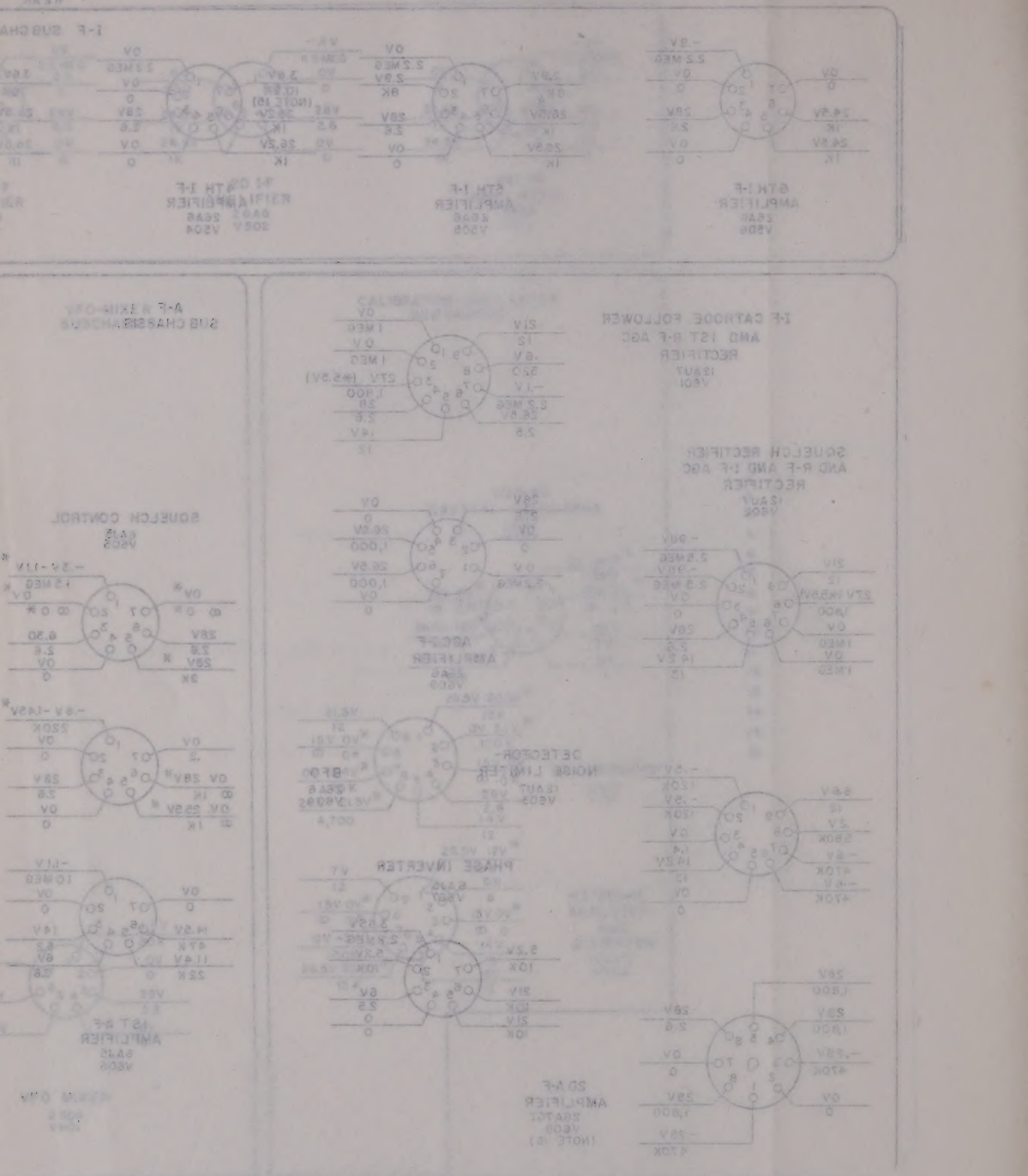
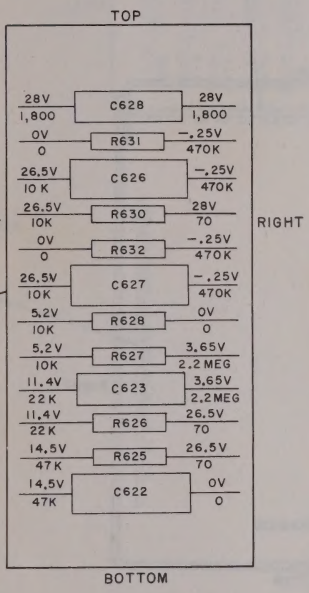
Figure 79. Lower deck, voltage and resistance diagram.



RIGHT



NOTES:

1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, AND ARE MEASURED FROM BOARD TERMINAL TO GROUND WITH A 20,000 OHMS-PER-VOLT METER (SUCH AS MULTIMETER TS-352 VOLTAGES ARE DC AND ARE MEASURED FROM BOARD TERMINAL TO GROUND WITH A VTVM (SUCH AS ME-26/U
2. READINGS ARE THE SAME ON ALL BANDS.
3. ∞ INDICATES INFINITY.
4. UNLESS OTHERWISE NOTED, SET CONTROLS AS FOLLOWS: FUNTION SWITCH TO [NORMAL], [RF GAIN SQUELCH THRESH] CONTROL TO MAXIMUM CLOCKWISE, [AF GAIN] TO MAXIMUM CLOCKWISE, AND [BAND WIDTH] TO [8K]
5. READINGS IN PARENTHESIS ARE MADE WITH [BFO] SWITCH AT [ON]
6. READINGS ARE MADE WITH [AGC] SWITCH AT [CAL].

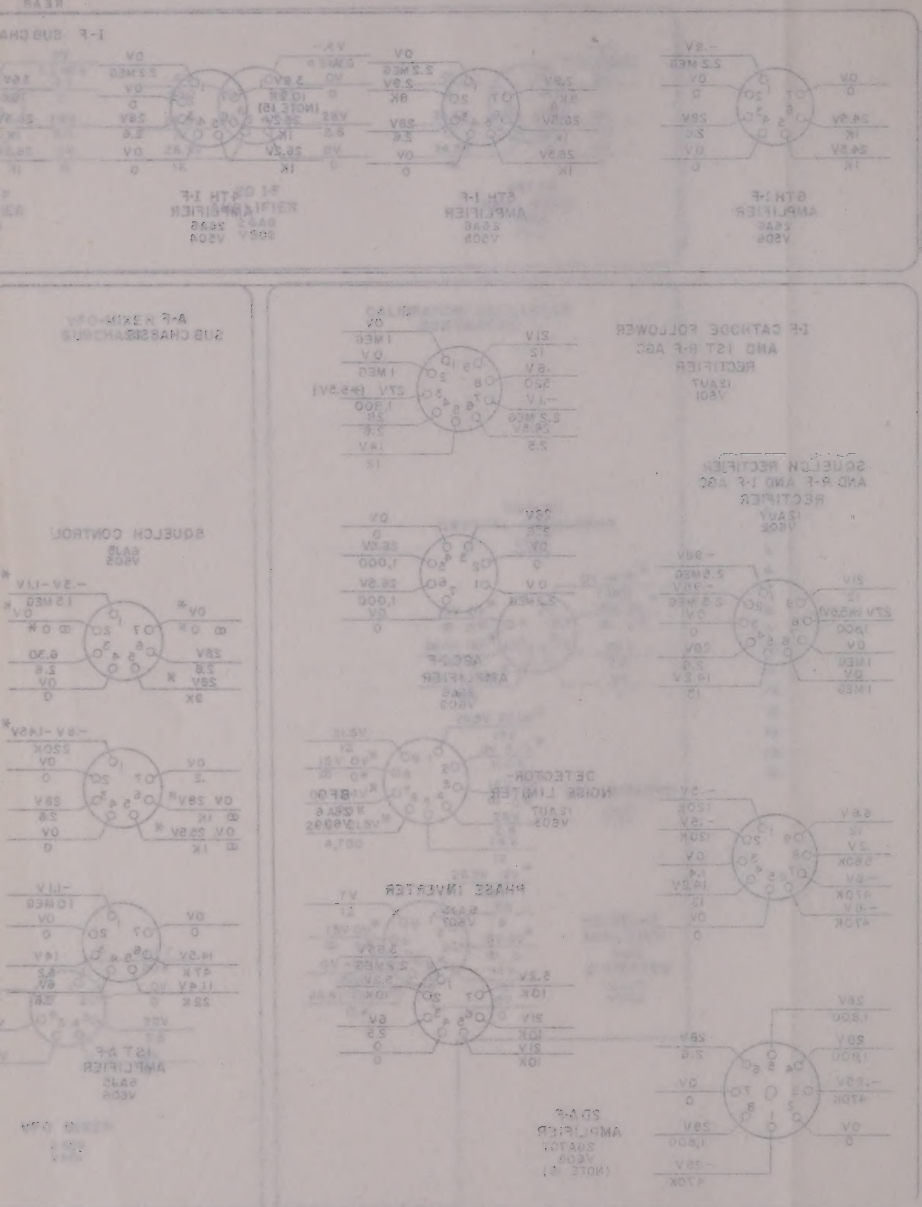


Figure 19. Lower deck, voltage and resistance diagram.

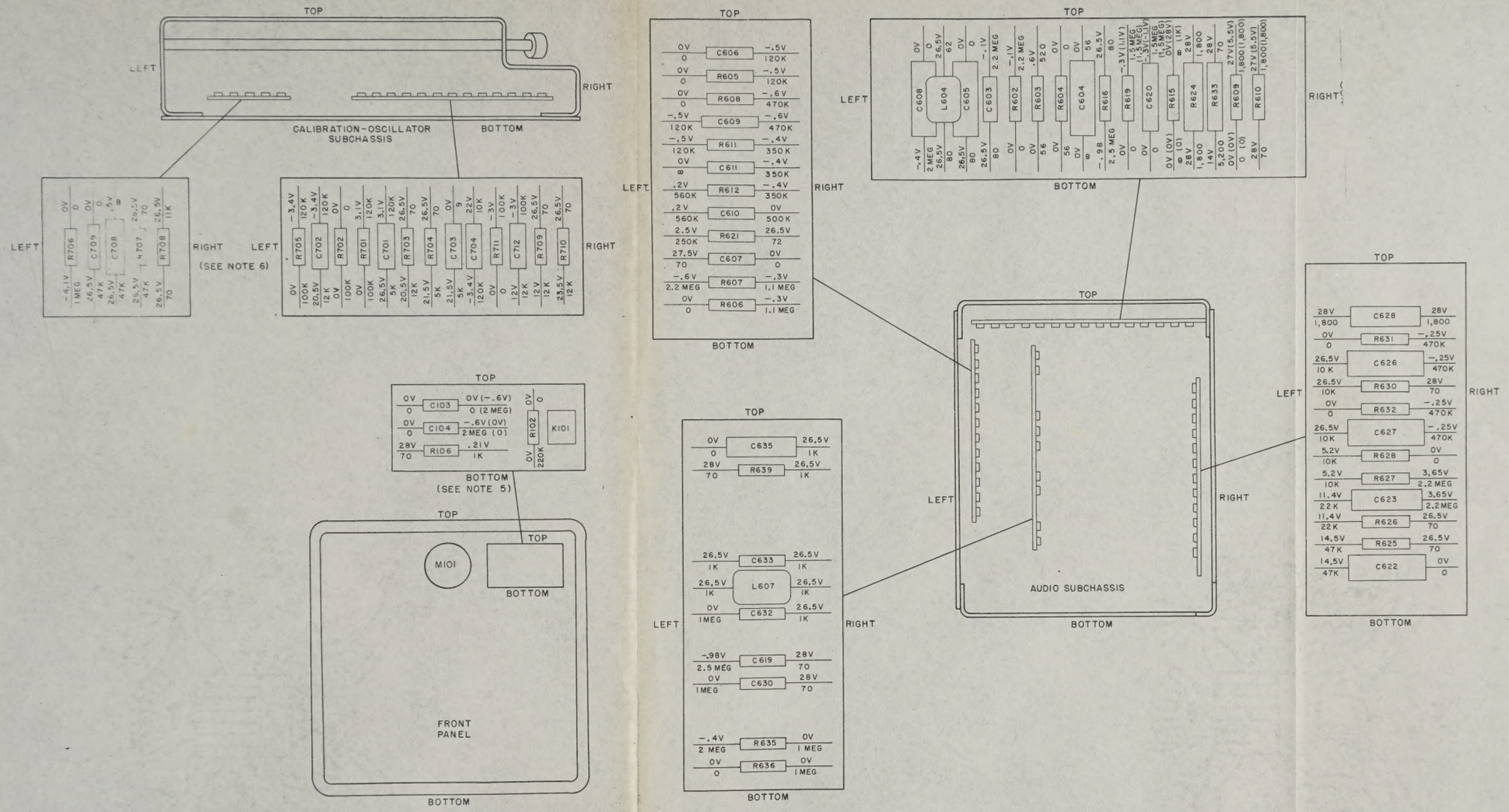


Figure 80. Terminal boards, voltage and resistance diagram.

NOTES:

1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, AND ARE MEASURED FROM BOARD TERMINAL TO GROUND WITH A 20,000 OHMS-PER-VOLT METER (SUCH AS MULTIMETER TS-352 VOLTAGES ARE DC AND ARE MEASURED FROM BOARD TERMINAL TO GROUND WITH A VTVM (SUCH AS ME-26/U
2. READINGS ARE THE SAME ON ALL BANDS.
3. ∞ INDICATES INFINITY.
4. UNLESS OTHERWISE NOTED, SET CONTROLS AS FOLLOWS:
   FUNTION SWITCH TO NORMAL, RF GAIN SQUELCH THRESH CONTROL TO MAXIMUM CLOCKWISE, AF GAIN TO MAXIMUM CLOCKWISE, AND BAND WIDTH TO 8K
5. READINGS IN PARENTHESIS ARE MADE WITH BFO SWITCH AT ON
6. READINGS ARE MADE WITH AGC SWITCH AT CAL.

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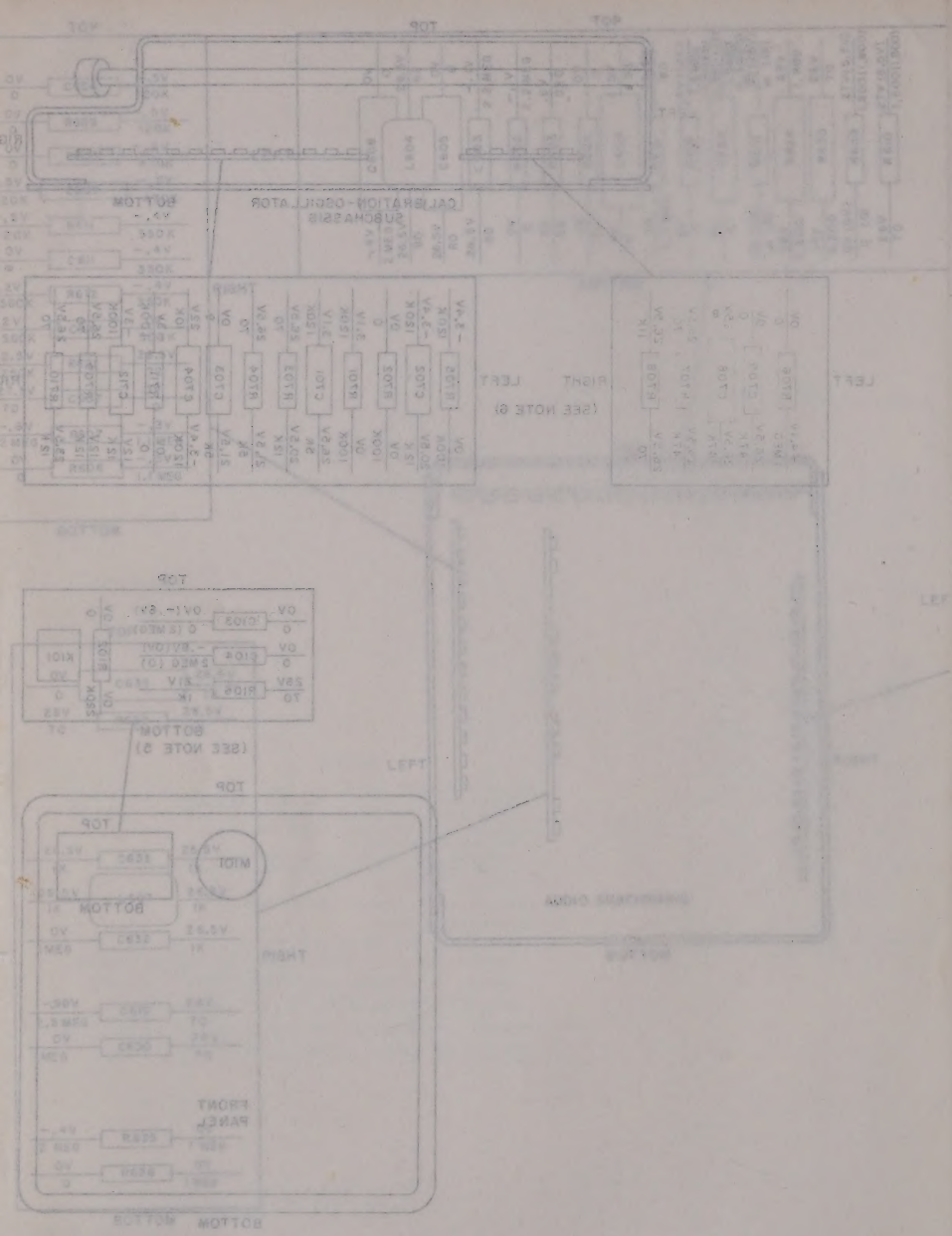
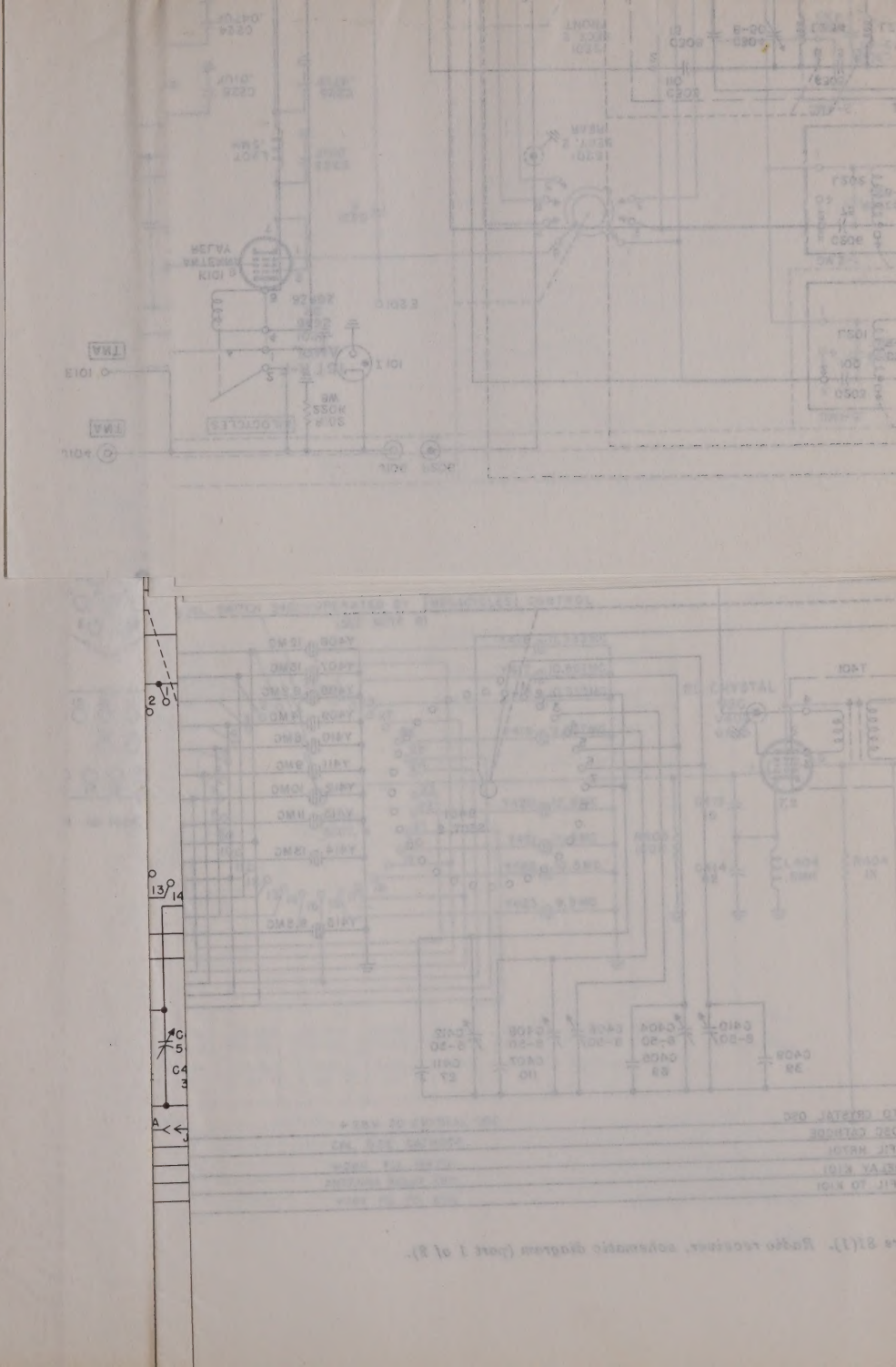




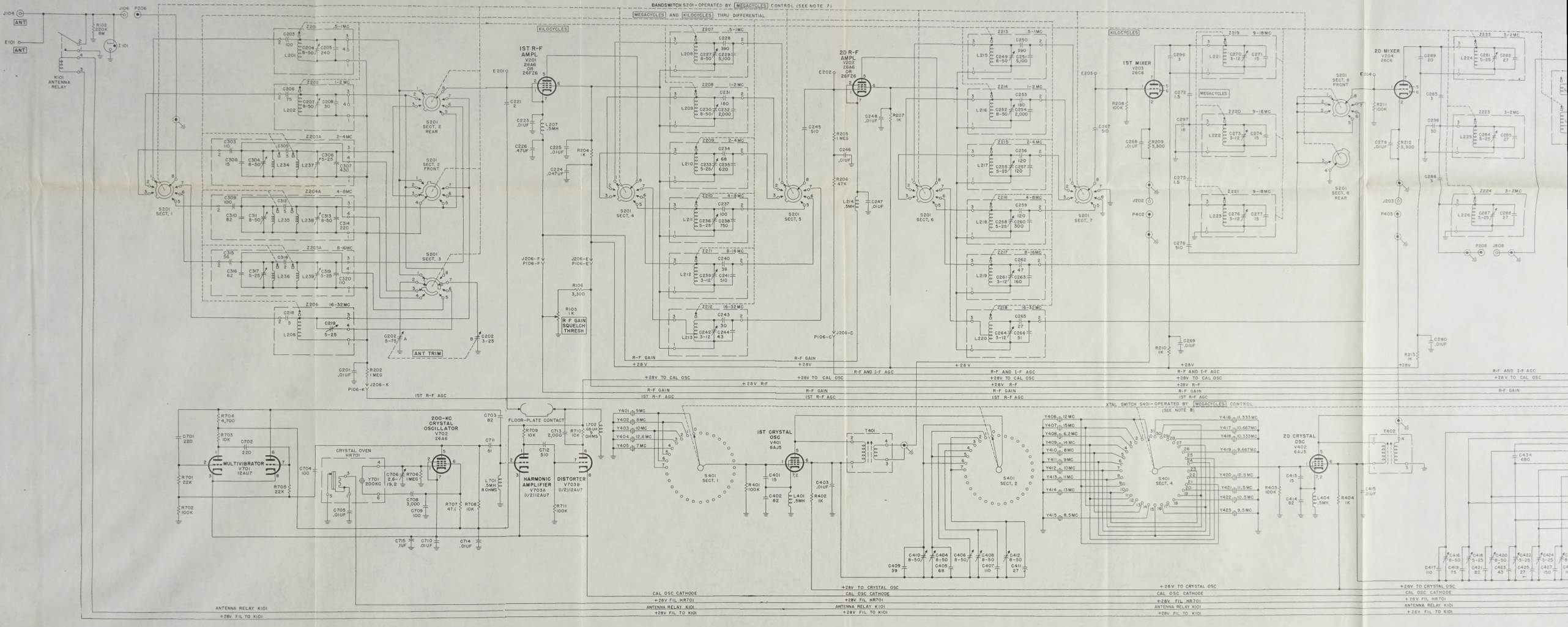


Figure 81(1). Radio receiver, schematic diagram (part 1 of 2).

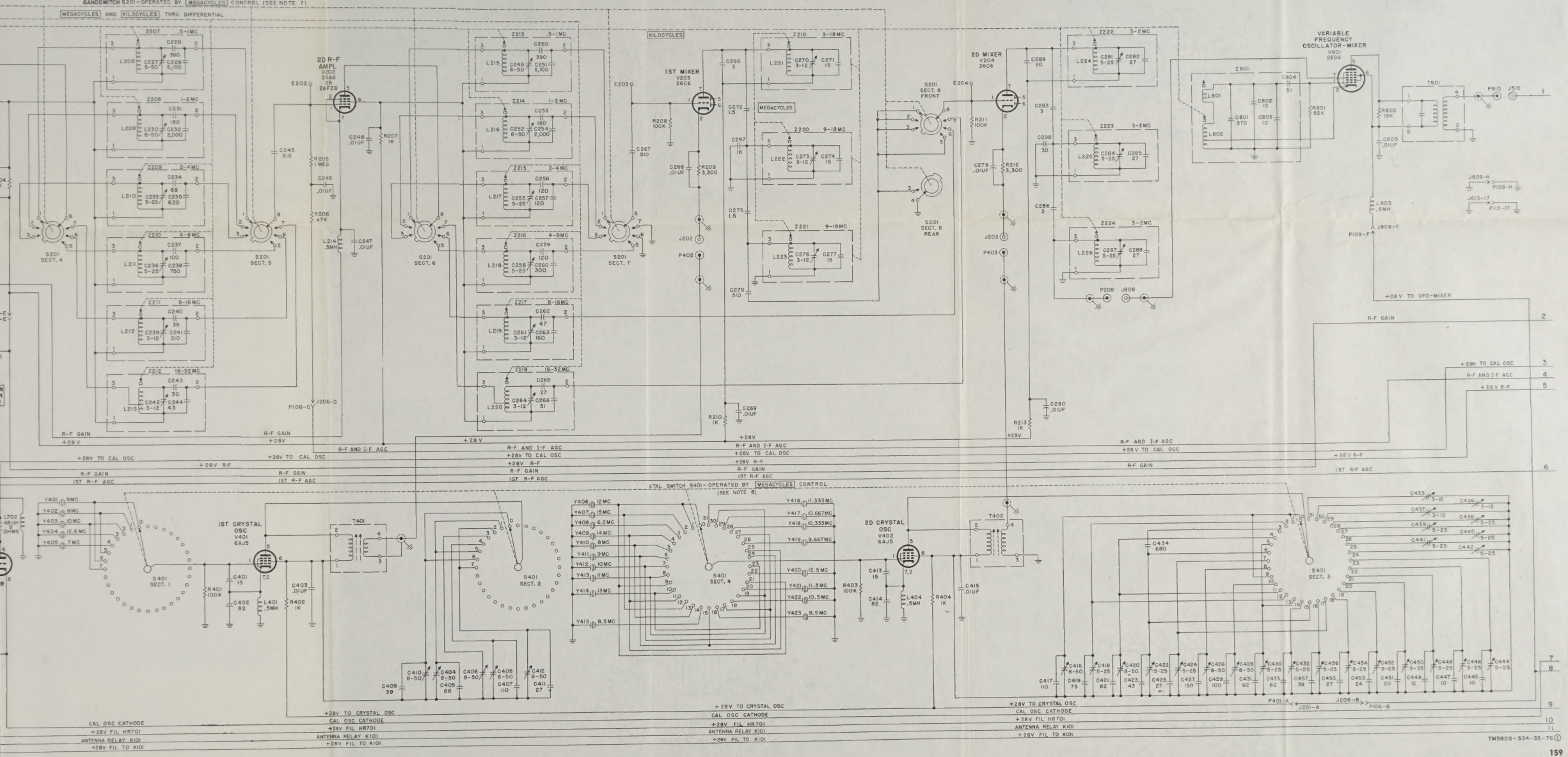
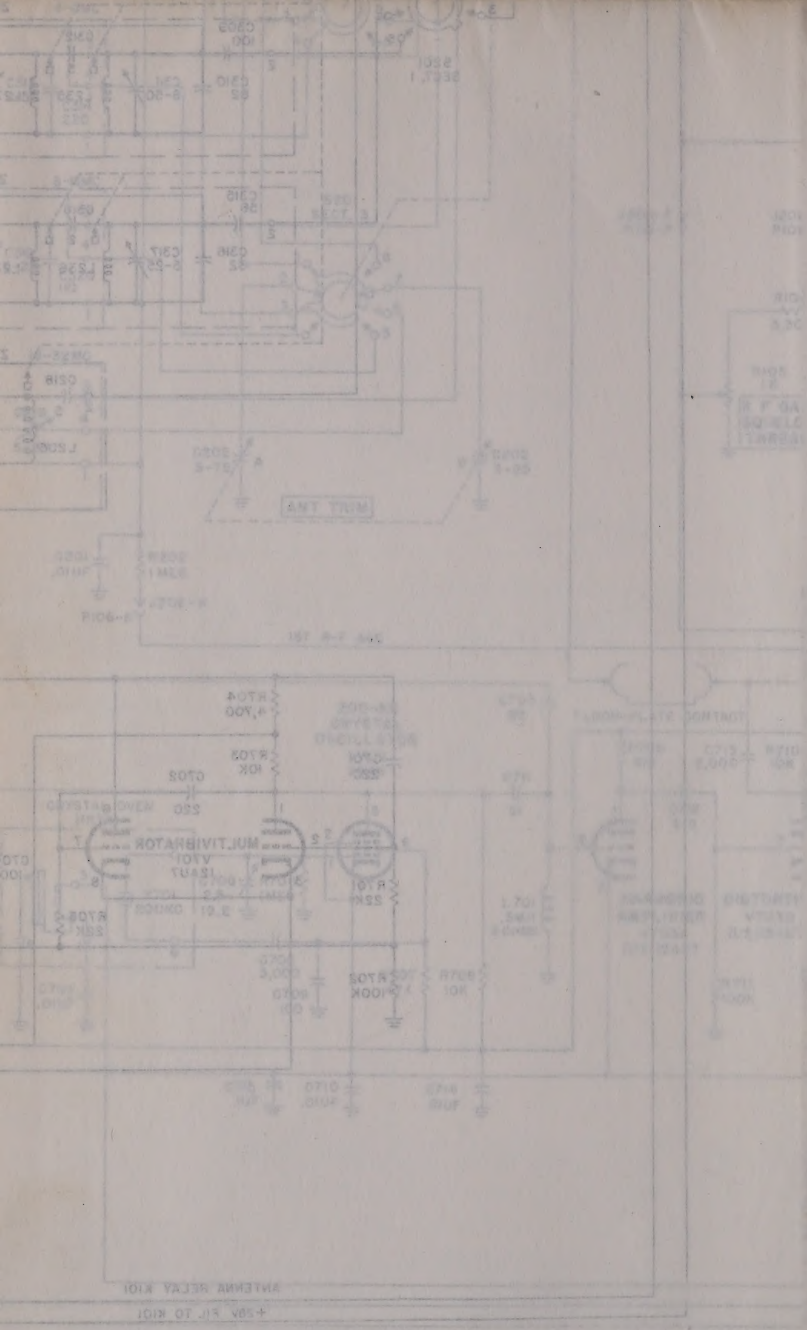
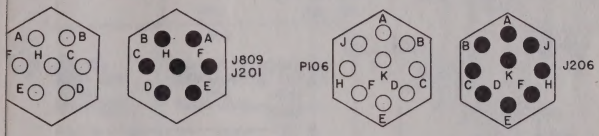


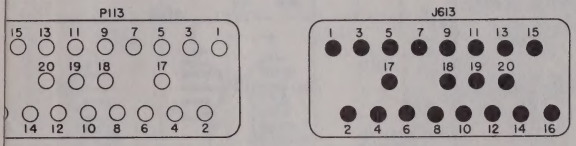
Figure 81(1). Radio receiver, schematic diagram (part 1 of 2).


ANT TRIM
MULTIVIBRATOR

PIN K.....CARRIER CONTROL

5. CONTACTS A AND D OF J103 ARE CONNECTED TOGETHER WHEN EITHER ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLY CX-1597/U OR ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLY CX-1599/U ARE USED.





4 AN AUDIO MODULE IS USED IN PLACE OF V608 IN CERTAIN RECEIVERS. SEE TEXT.

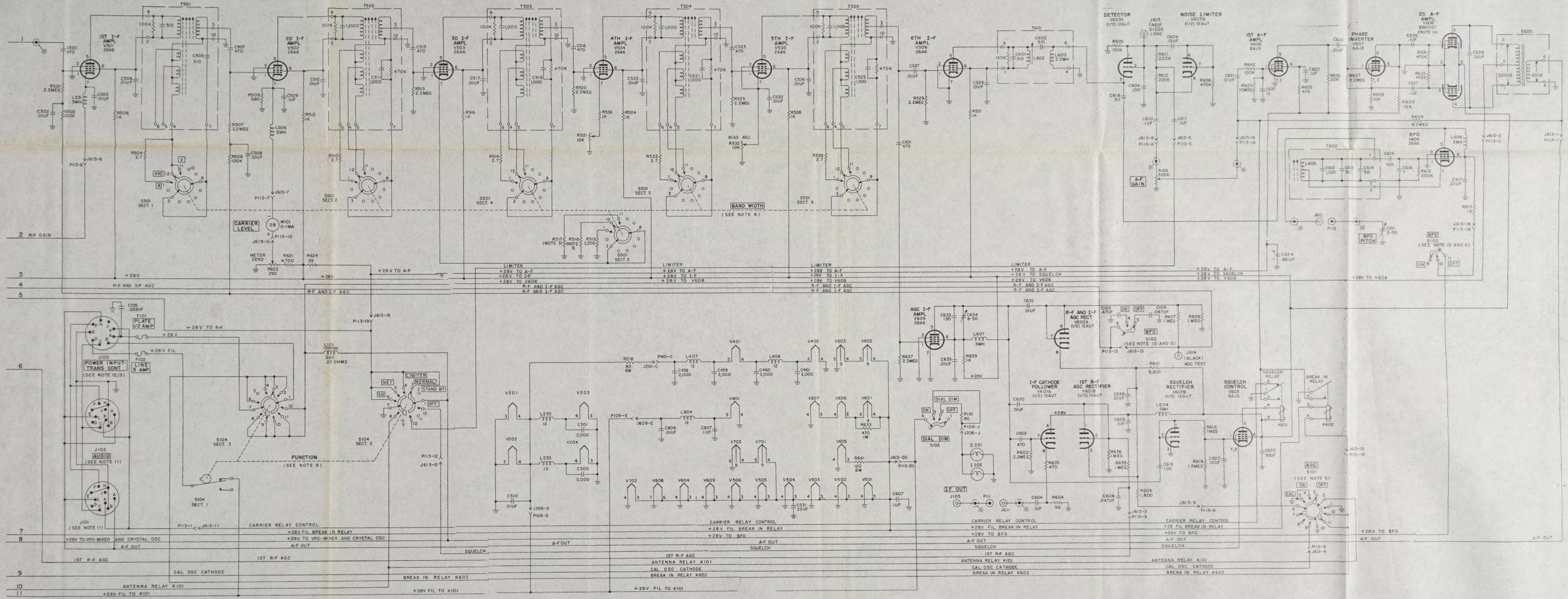


Figure 81(2). Radio receiver, schematic diagram (part 2 of 2).

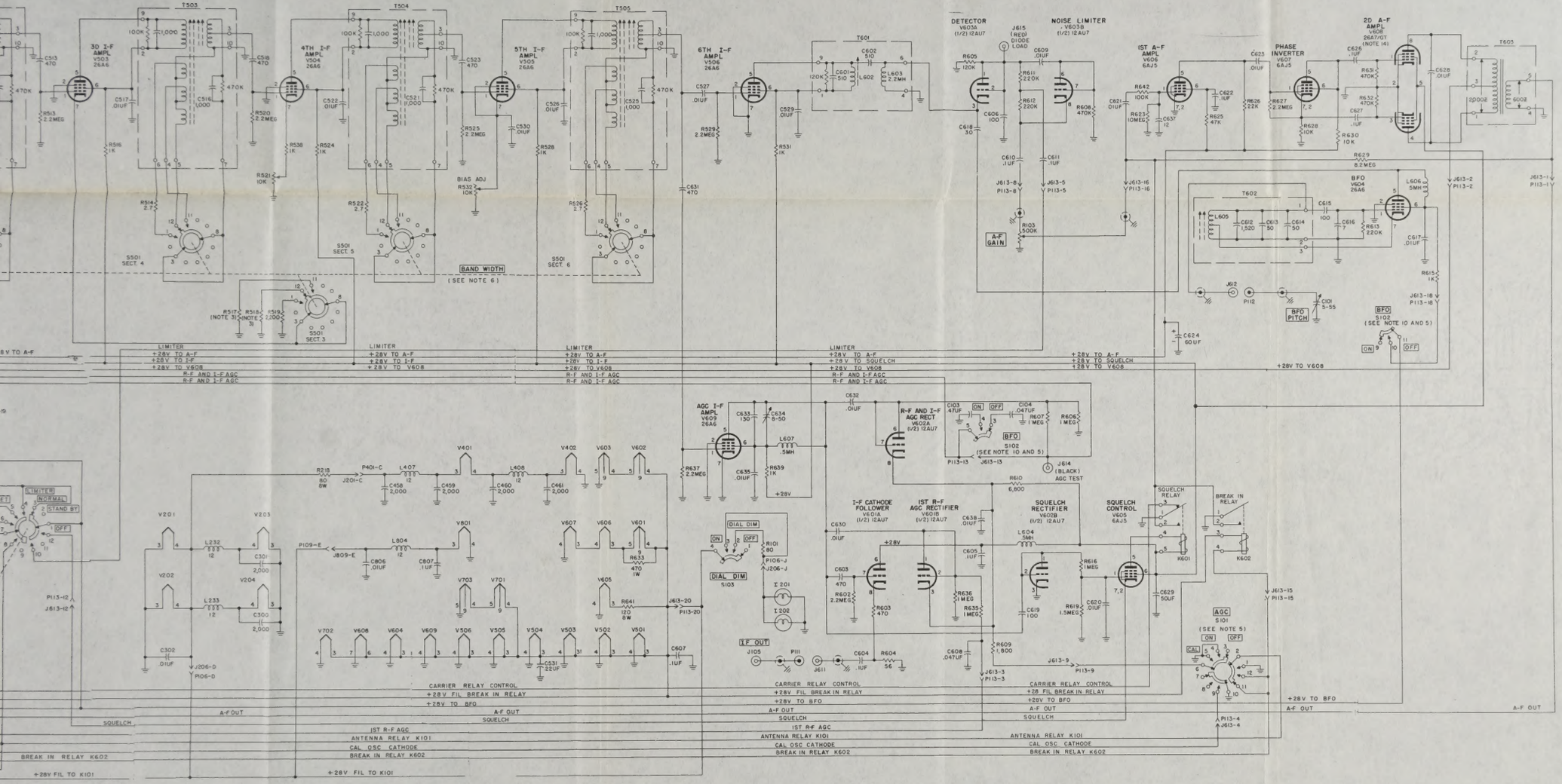
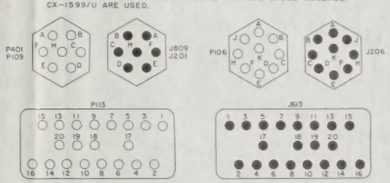

T503
T504
T505
T601
T602
T603
3D I-F AMPL V503 26A6
4TH I-F AMPL V504 26A6
5TH I-F AMPL V505 26A6
6TH I-F AMPL V506 26A6
DETECTOR V605A (1/2) 12AU7
NOISE LIMITER V603B (1/2) 12AU7
J615 (RED) DIODE LOAD
1ST A-F AMPL V606 6AJ5
PHASE INVERTER V607 6AJ5
2D A-F AMPL V608 2X6/6GT (NOTE 14)
BFO V604 26A6
BAND WIDTH (SEE NOTE 6)
S501 SECT 3
S501 SECT 4
S501 SECT 5
S501 SECT 6
BIAS ADJ R532 10K
A-F GAIN R103 500K
BFO PITCH C101 5-55
BFO S102 (SEE NOTE 10 AND 5)
LIMITER +28V TO A-F +28V TO I-F +28V TO V608 R-F AND I-F AGC
LIMITER +28V TO A-F +28V TO I-F +28V TO V608 R-F AND I-F AGC
LIMITER +28V TO A-F +28V TO V608 R-F AND I-F AGC
LIMITER +28V TO A-F +28V TO SQUELCH +28V TO V608 R-F AND I-F AGC
+28V TO A-F +28V TO SQUELCH +28V TO V608
+28V TO V608
AGC I-F AMPL V609 26A6
R-F AND I-F AGC RECT V602A (1/2) 12AU7
I-F CATHODE FOLLOWER V601A (1/2) 12AU7
1ST R-F AGC RECTIFIER V601B (1/2) 12AU7
SQUELCH RECTIFIER V602B (1/2) 12AU7
SQUELCH CONTROL V605 6AJ5
SQUELCH RELAY
BREAK IN RELAY
K601
K602
AGC S101 (SEE NOTE 5)
J614 (BLACK) AGC TEST
DIAL DIM S103
I 201
I 202
IF OUT J105
CARRIER RELAY CONTROL
+28V FIL BREAK IN RELAY
+28V TO BFO
A-F OUT
SQUELCH
1ST R-F AGC
ANTENNA RELAY K101
CAL OSC CATHODE
BREAK IN RELAY K602
+28V FIL TO K101
+28V TO BFO
A-F OUT

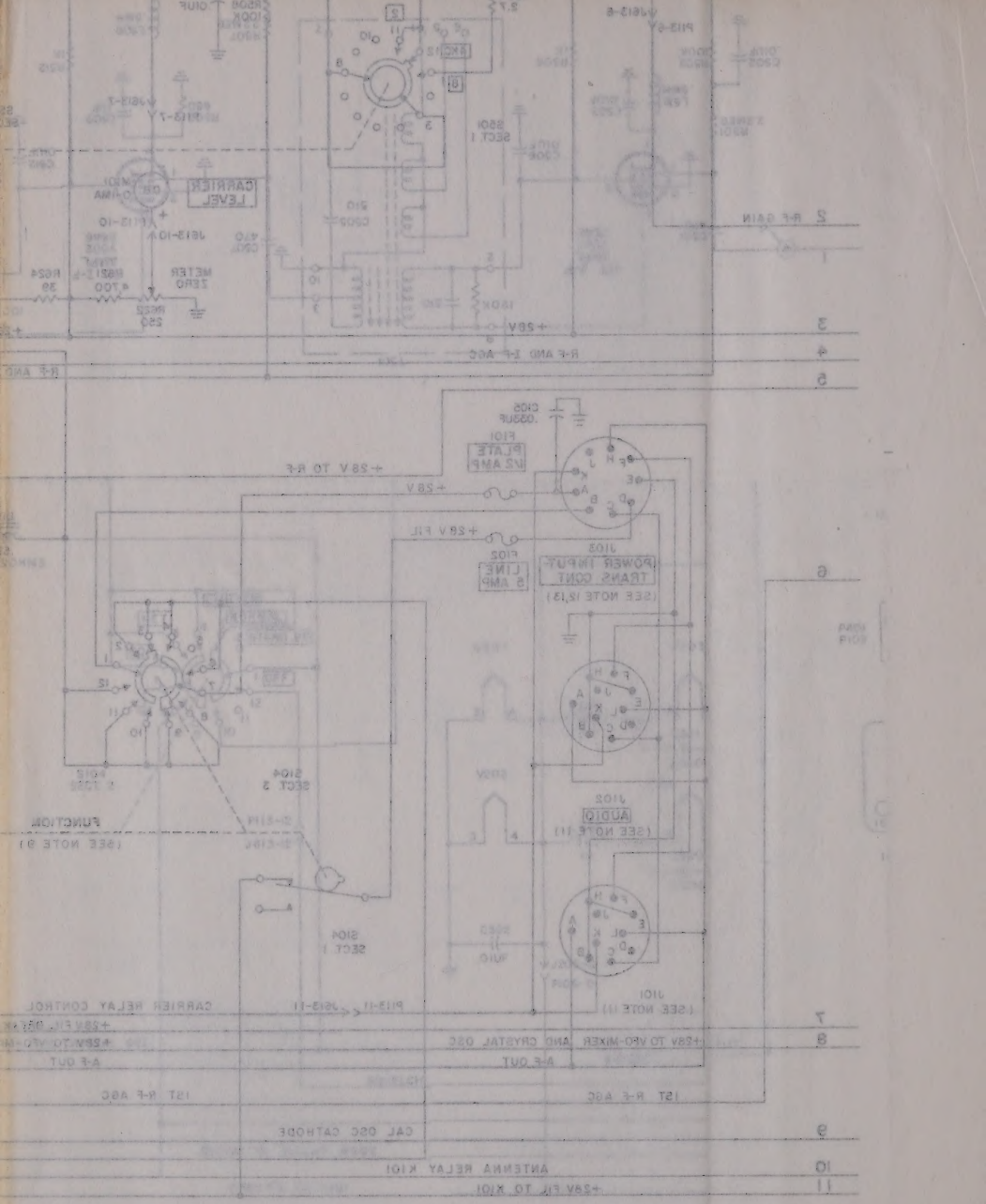
Figure 81(2). Radio receiver, schematic diagram (part 2 of 2).

NOTES:

1. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF, INDUCTORS ARE IN UH.
2. ALL SWITCHES ARE SHOWN ON THIS DIAGRAM AS VIEWED FROM THE END OPPOSITE THE KNOB OR DRIVEN END. SECTIONS DESIGNATED AS 1 ARE CLOSEST TO THE KNOB.
3. R517 SELECTED AT FINAL TEST. NOMINAL VALUE 6,800 OHMS. R518 SELECTED AT FINAL TEST. NOMINAL VALUE 18K OHMS.
4. ALL RELAYS ARE SHOWN IN THEIR DEENERGIZED POSITIONS.
5. AGC SWITCH S101 AND BFO SWITCH S102 ARE SHOWN IN OFF POSITION.
6. BANDWIDTH SWITCH S501 IS SHOWN IN 4KC POSITION.
7. BANDSWITCH S201 IS SHOWN IN .5 TO 1MC FREQUENCY RANGE OR BAND POSITION.
8. CRYSTAL SWITCH S401 SHOWN IN .5 TO 1MC BAND POSITION.
9. FUNCTION SWITCH S104 SHOWN IN NORMAL POSITION.
10. FOR CLARITY, BFO SWITCH S102 IS SHOWN IN 2 SECTIONS.
11. THE FOLLOWING IS THE FUNCTION OF PINS IN AUDIO RECEPTACLES J101 AND J102:
    PIN A.....A-F OUTPUT
    PIN B.....GROUND
    PIN C.....MICROPHONE
    PIN D.....NO CONNECTION
    PIN E.....GROUND
    PIN F.....PUSH TO TALK SWITCH ON MICROPHONE OR KEY
    PIN H.....GROUND
    PIN J.....NO CONNECTION
    PIN K.....CARRIER RELAY CONTROL
    PIN L.....A-F OUTPUT
12. THE FOLLOWING IS THE FUNCTION OF PINS OF POWER INPUT-TRANS CONT RECEPTACLE J103
    PIN A.....28V B+ (POSITIVE VOLTAGE)
    PIN B.....BREAK-IN RELAY CONTROL
    PIN C.....MICROPHONE
    PIN D.....28V FILAMENT (POSITIVE VOLTAGE)
    PIN E.....GROUND
    PIN F.....PUSH TO TALK SWITCH ON MICROPHONE OR KEY
    PIN H.....A-F OUTPUT
    PIN J.....NO CONNECTION
    PIN K.....CARRIER CONTROL
13. CONTACTS A AND D OF J103 ARE CONNECTED TOGETHER WHEN EITHER ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLY CX-1597/U OR ELECTRICAL SPECIAL PURPOSE CABLE ASSEMBLY CX-1599/U ARE USED.



14. AN AUDIO MODULE IS USED IN PLACE OF V608 IN CERTAIN RECEIVERS. SEE TEXT.


CARRIER LEVEL
METER ZERO
+28V
R-F AND I-F AGC
+28V TO R-F
+28V F/L
PLATE 1/2 AMP
LINE 5 AMP
POWER INPUT TRANS CONT
(SEE NOTE 12,13)
AUDIO
(SEE NOTE 11)
FUNCTION
(SEE NOTE 9)
CARRIER RELAY CONTROL
+28V TO VFO-MIXER AND CRYSTAL OSC
R-F OUT
1ST R-F AGC
CAL OSC CATHODE
ANTENNA RELAY K101
+28V F/L TO K101

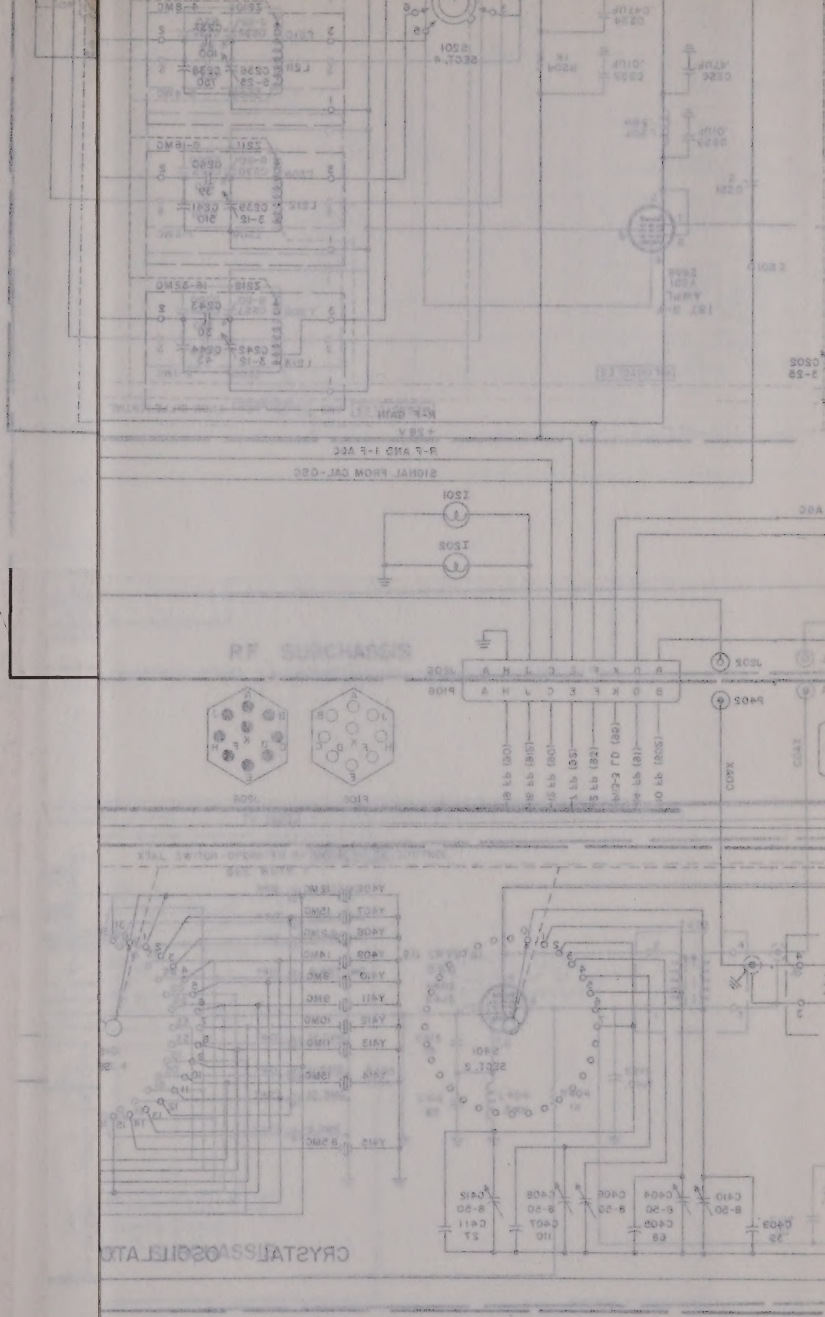
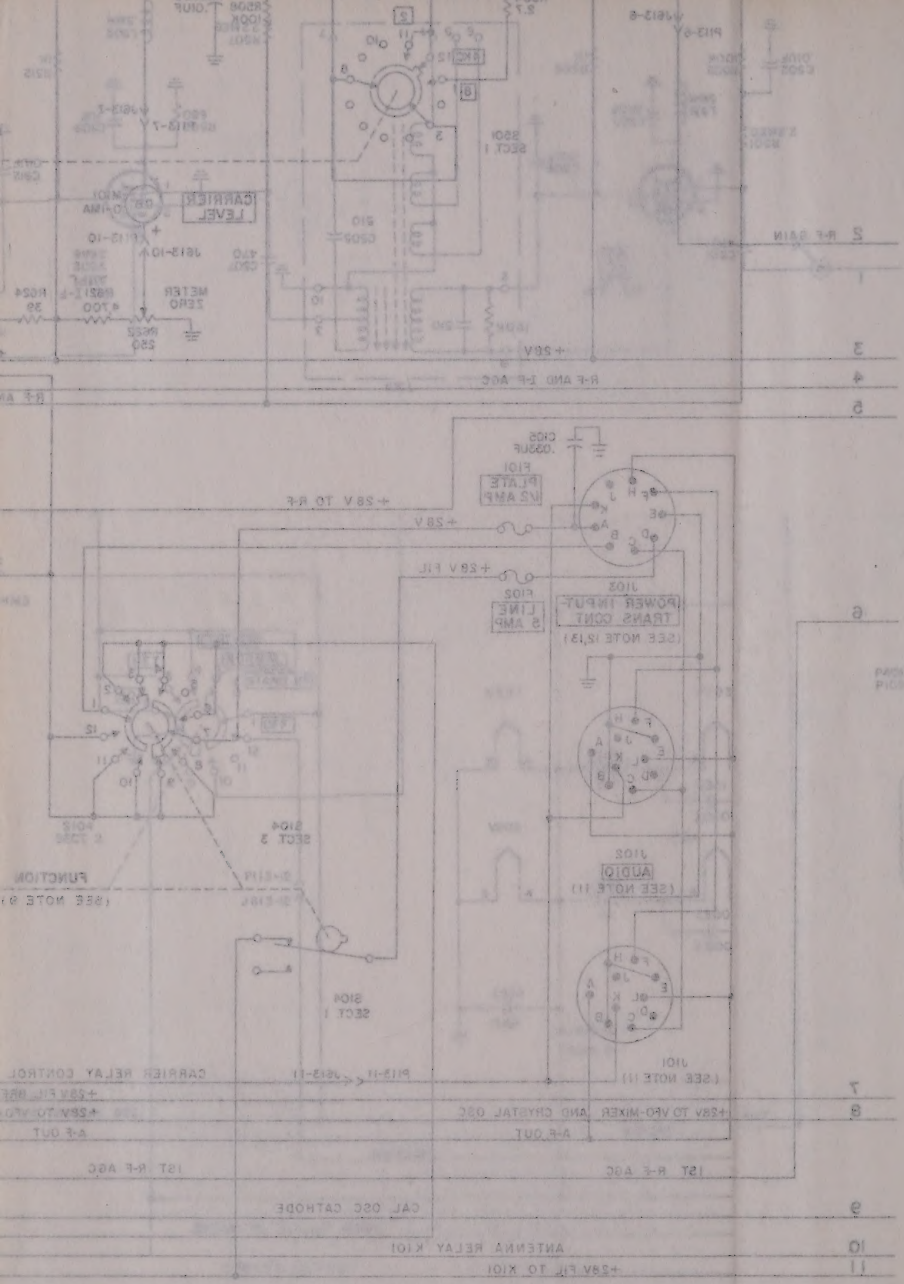


Fig. 52(1). Radio receiver, wiring diagram (part 1 of 2).


+28V
R-F AND I-F AGC
+28V TO R-F
+28V FIL
POWER INPUT
TRANS CONT
(SEE NOTE 12,13)
AUDIO
(SEE NOTE 11)
(SEE NOTE 11)
+28V TO VFO-MIXER AND CRYSTAL OSC
A-F OUT
1ST R-F AGC
CAL OSC CATHODE
ANTENNA RELAY K101
+28V FIL TO K101

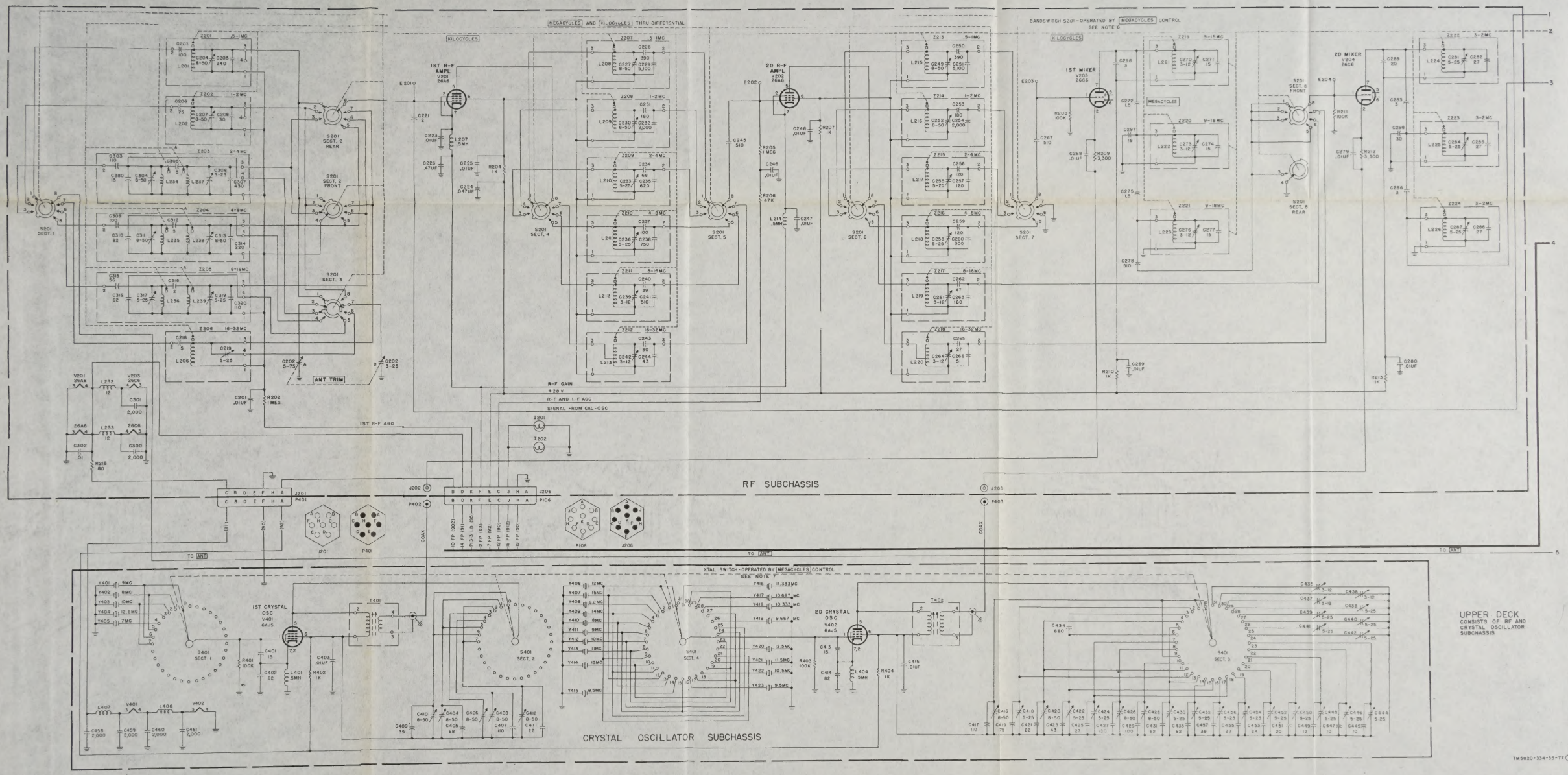
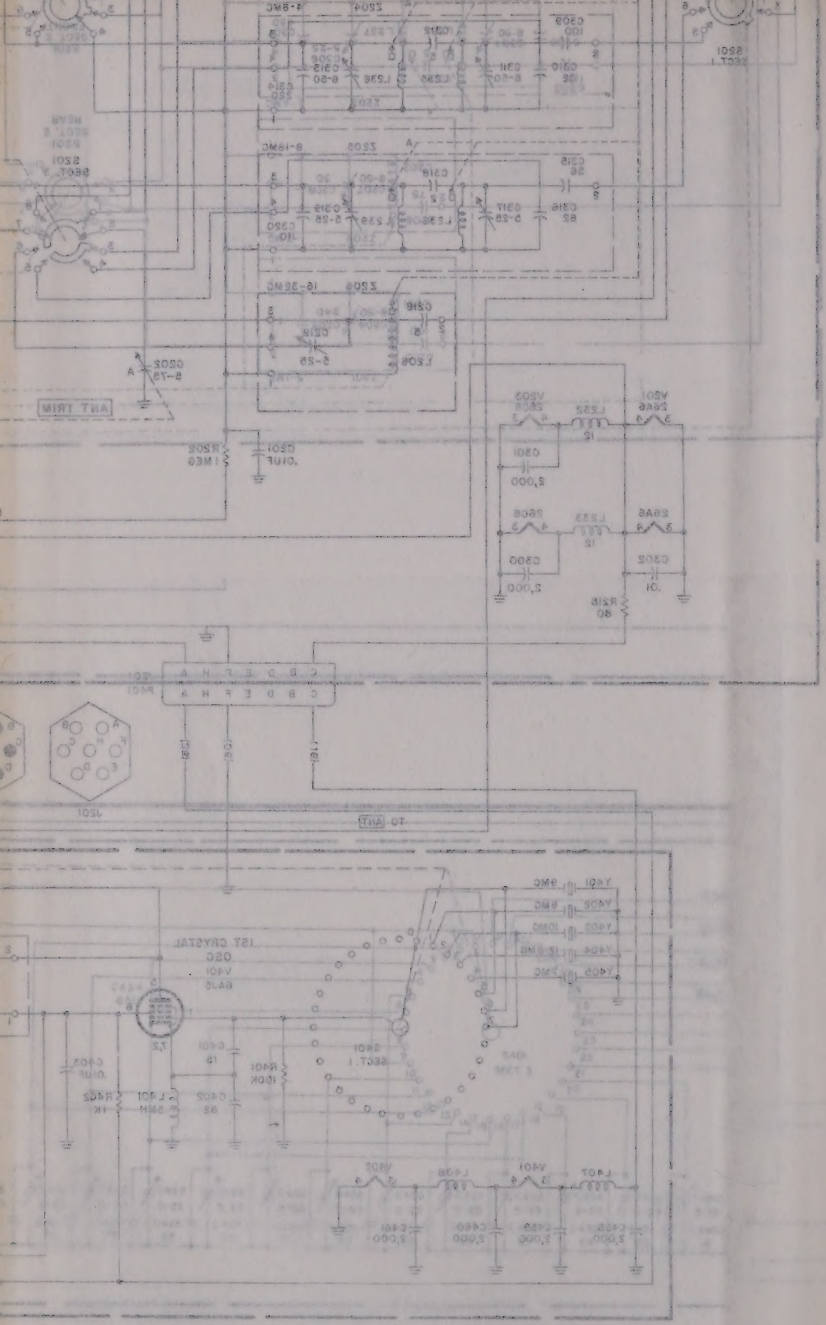
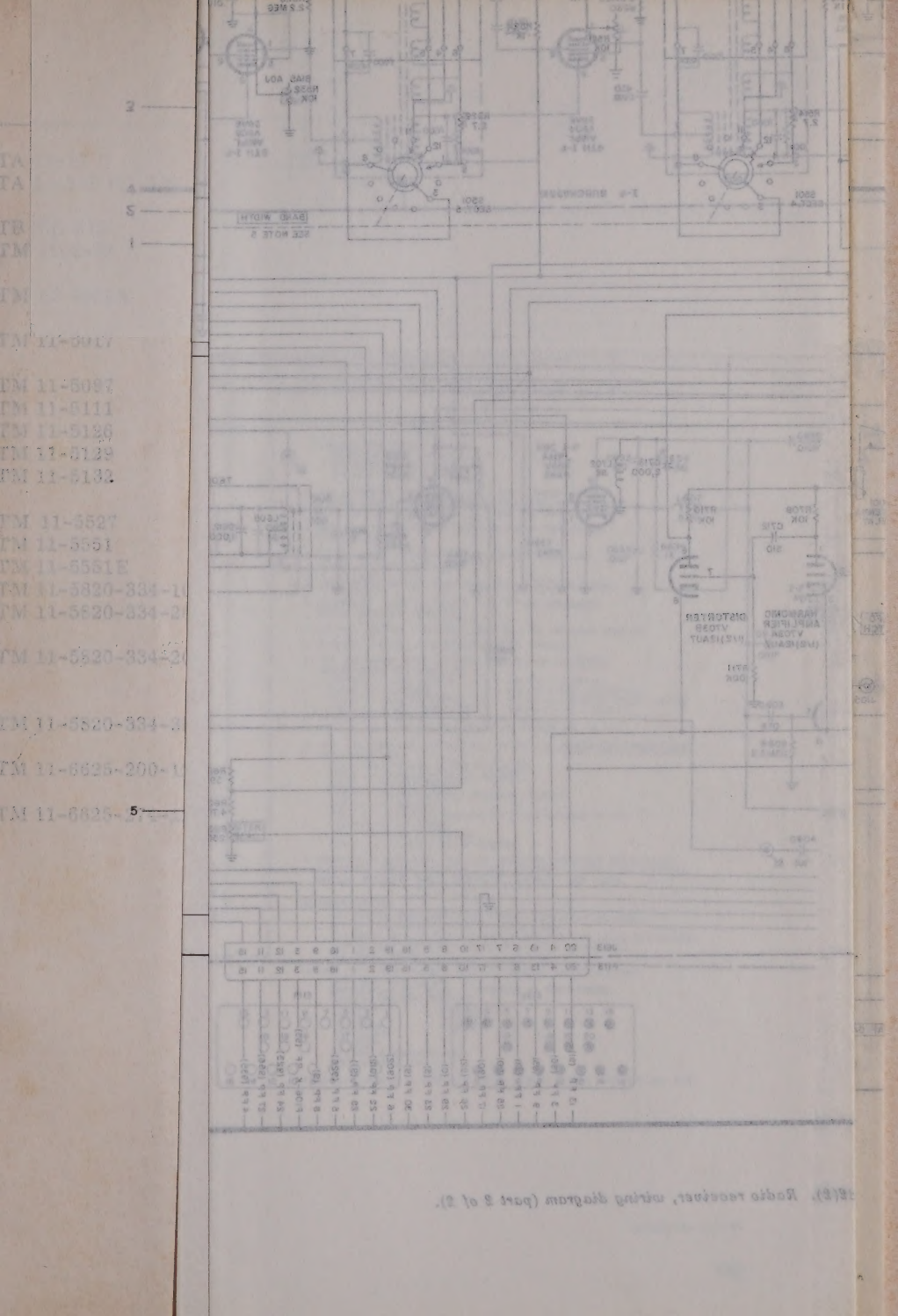
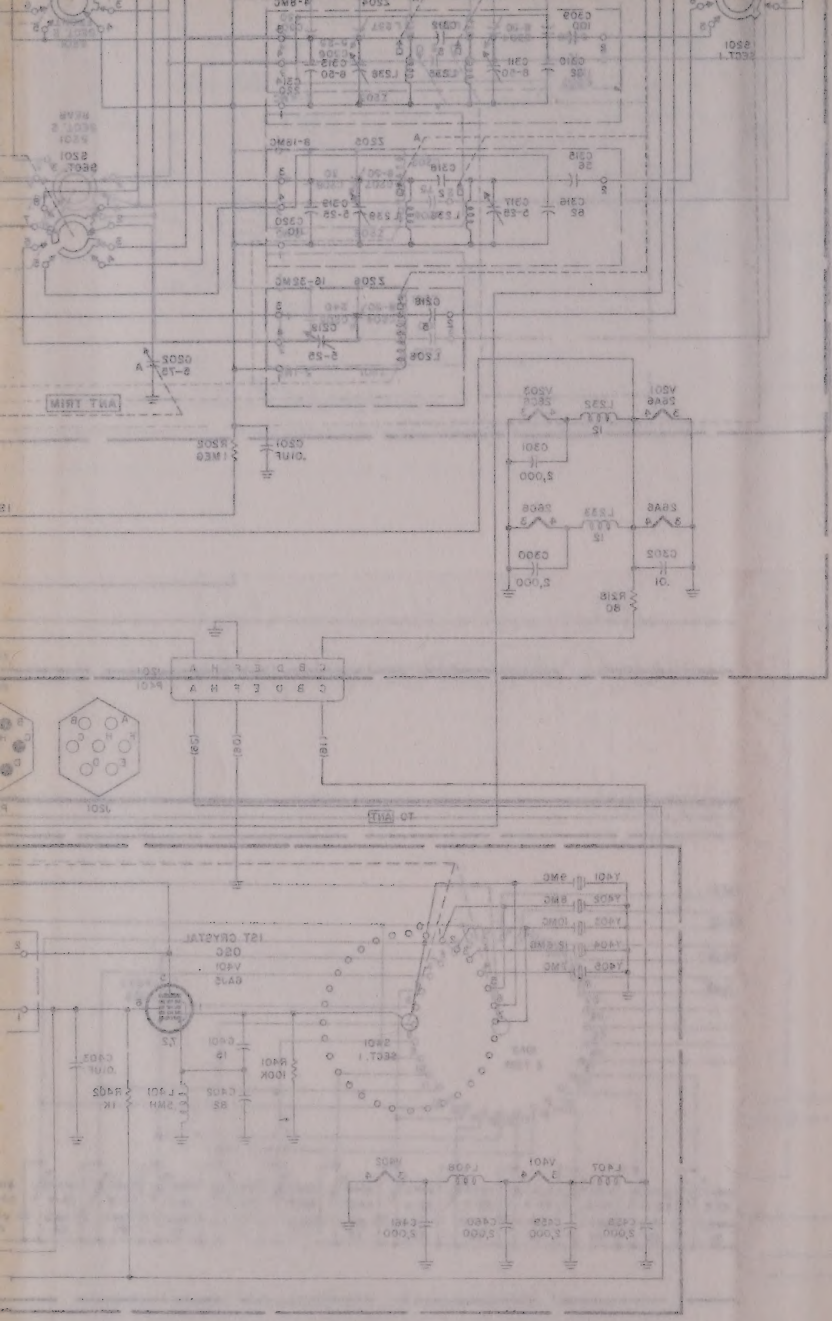


Figure 82(1). Radio receiver, wiring diagram (part 1 of 21.







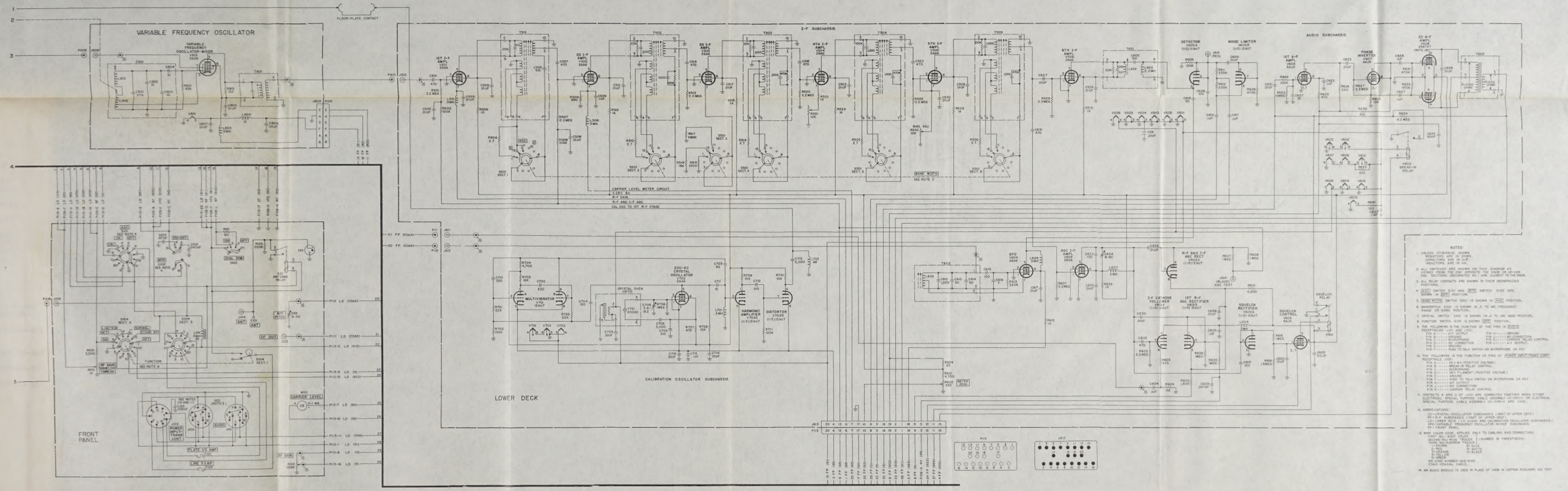


Figure 82(2). Radio receiver, wiring diagram (part 2 of 2).

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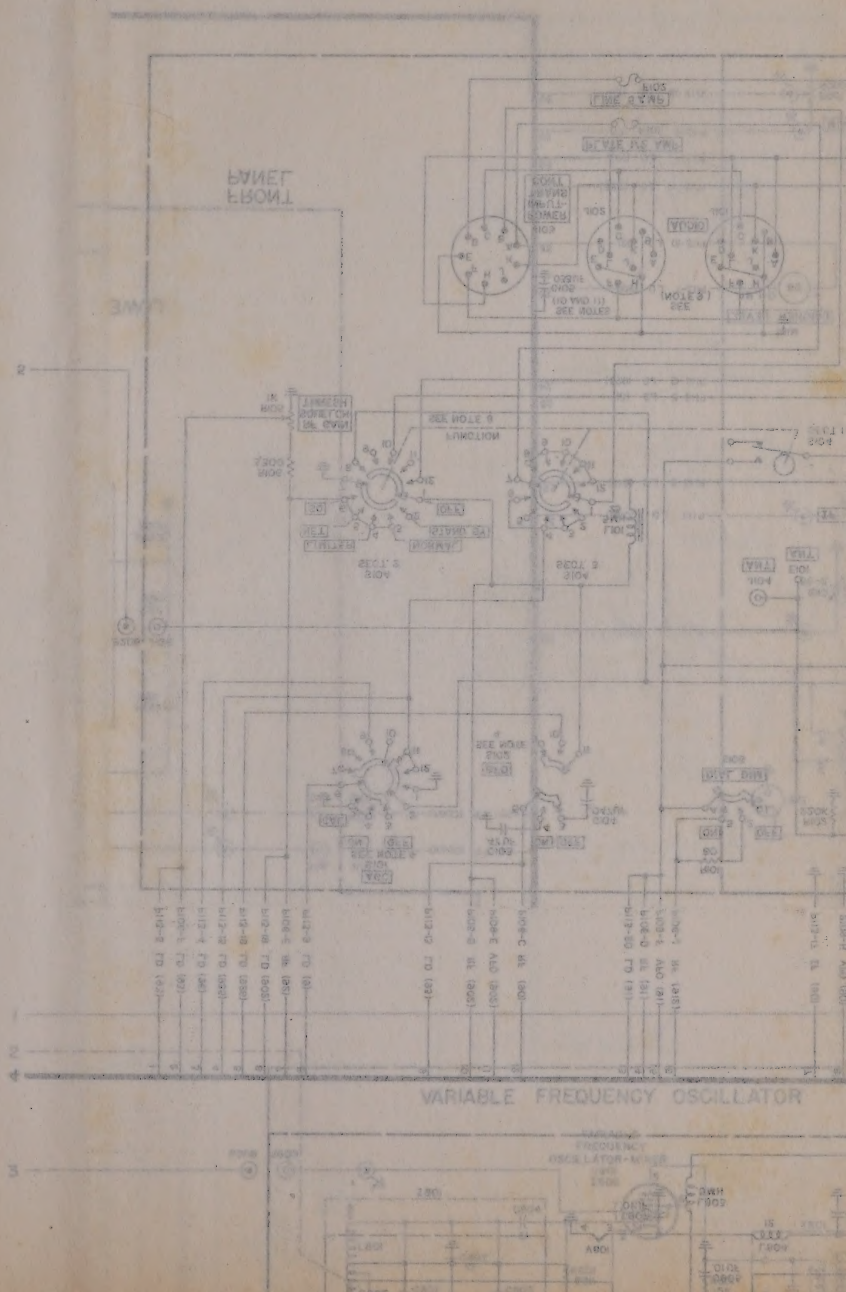
VARIABLE FREQUENCY OSCILLATOR

APPENDIX

REFERENCES

TA 11-17	Signal Field Maintenance Shops.
TA 11-100 (11-17)	Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shops.
TB SIG 319	Electronic Equipment Maintenance Kit MK-288/URM.
TM 11-2684	Audio Oscillators TS-312/FSM-1, TS-312A/FSM-1, and TS-382/U, and Signal Generator TS-312B/FSM-1.
TM 11-2684A	Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, and TS-382E/U.
TM 11-5017	Output Meters TS-585A/U, TS-585B/U, TS-585C/U, and TS-585D/U.
TM 11-5097	Spectrum Analyzers TS-723A/U and TS-723/U.
TM 11-5111	Power Supplies PP-1097A/G and PP-1097B/G.
TM 11-5126	Power Supply PP-1104A/G.
TM 11-5129	Oscilloscope AN/USM-50A, B, and C.
TM 11-5132	Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U and ME-30C/U.
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
TM 11-5551	Instruction Book for Rf Signal Generator Set AN/URM-25.
TM 11-5551E	R. F. Signal Generator AN/URM-25F.
TM 11-5820-334-10	Operator's Manual: Radio Receiver R-392/URR.
TM 11-5820-334-20	Organizational Maintenance Manual: Radio Receiver R-392/URR.
TM 11-5820-334-20P	Organizational Maintenance Repair Parts and Special Tool List and Maintenance Allocation Chart: Receiver, Radio R-392/URR.
TM 11-5820-334-35P	Field and Depot Maintenance Repair Parts and Special Tools List: Receiver, Radio R-392/URR.
TM 11-6625-200-12	Operation and Organizational Maintenance: Multimeter ME-26B/U.
TM 11-6625-274-12	Operator's and Organizational Maintenance Manual: Test Sets, Electron Tube TV-7/U, TV-7A/U, TV-7B/U, and TV-7D/U.

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